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Symposium on the Provision of Laboratory Diagnostic Services

1.—Introduction

BY

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IF one thinks about our status as a scientific profession it largely depends on our knowledge of the aetiologies of the problems we have to tackle. This is true whether we are thinking in terms of animal husbandry, preventive medicine, or clinical medicine and surgery. A knowledge of aetiology must be coupled with precision in diagnosis before any rational remedy can be applied. At to-day's stage of development of veterinary science this diagnostic precision is increasingly dependent on laboratory methods. It is not too sweeping to say that a veterinary practice in this country which is habitually run without recourse to laboratory aids cannot be said to be giving its best to its clients. Microbial infections, parasitisms and disorders of metabolism all need laboratory methods for their definition.

Over the last 30 years we have seen a gradual extension of this reliance on laboratory aids and it is a partial reflection of our scientific growth and development as a learned profession. This increasing need of laboratory help was reflected in a discussion which took place in the Council of the British Veterinary Association nearly 2 years ago. In that discussion some anxiety was expressed about the facilities available to practising veterinary surgeons and it was decided to appoint a sub-committee to look into the problem of laboratory facilities and ancillary aids to practice.

The sub-committee was set up by the General Purposes and Finance Committee on January 21st, 1960, to implement the Council's resolution of November 6th, 1959, to the effect "that the whole question of laboratory services available to the veterinary profession should be considered by a special sub-committee of the appropriate standing committee."

The sub-committee decided that their remit could best be undertaken under 2 broad headings:

(1) to ascertain the laboratory and ancillary services now available to practising veterinary surgeons.

(2) to what extent these services meet the existing needs of practising veterinary surgeons, and whether they should be expanded and improved.

To obtain this information 2 sets of questionnaires were devised, one for the institutions and organisations likely to provide laboratory and ancillary services and the other for veterinary surgeons in practice. The first questionnaire was sent to the Central Veterinary Laboratory, Weybridge, for distribution to the Veterinary Investigation Service, the veterinary advisory centres in Scotland, all the veterinary schools, the Animal Health Trust, all commercial firms employing veterinary advisers and the veterinary laboratory of the Government of Northern Ireland. The second questionnaire was distributed to all the members of the Society of Practising Veterinary Surgeons and the British Small Animals Veterinary Association. Replies were received from 238 veterinary surgeons in practice.

The amount of information so obtained was considerable and provided us with a very complete picture of the present position from the point of view of both the "suppliers" and the "consumers." You would not wish me, nor is it my intention to burden you with the detailed statistical findings, but the following figures for the Veterinary Investigation Service give some idea of the volume of work undertaken. These are based on 21 Centres in England and Wales.

Total number of *post-mortem* examinations of poultry	60,889
Total number of *post-mortem* examinations of farm animals	25,568
Total number of *post-mortem* examinations of other animals and birds	2,803
Average number of examinations of all types per centre	18,951
Average number of *post-mortem* examinations per centre	4,250
Total examinations of all types	398,010

The average number of veterinary practices per centre based on 15 centres was 62 and the average total examinations at centres per practice was 336.

The areas dependent on any particular centre show variations in size, their animal populations, the num-

* Papers presented to the Annual Congress of the British Veterinary Association in Oxford on Thursday, September 7th, 1961.

ber of veterinary practices, and the ease of travel within the area. In certain areas, such as Cornwall, West Wales, and the Highlands of Scotland, the journey to the centre may take the best part of a working day, and from many practices in other areas return journeys of over 70 miles are not uncommon. On the other hand East Anglia would seem to be well served with 2 centres, at Cambridge and Norwich, 2 Animal Health Trust Stations concerned with farm animals, the University of Cambridge Veterinary School and the Field Station of the Royal Veterinary College, all within a radius of 60 miles.

To-day it is my duty to introduce and outline our problem before my colleagues discuss our particular needs and means of laboratory help.

At the onset I wish to make one point as strongly as possible. It should not be necessary, but time and again one has examples that this particular truth is forgotten. Laboratory methods are not synonymous with laboratory diagnosis. Investigations in a laboratory are merely another method of obtaining evidence which, coupled with that already obtained by history and direct examination of the problem may allow of a diagnosis. Laboratory investigation can never be a substitute for other methods of collecting evidence. Too often laboratory help is regarded as a last resort of those suffering diagnostic destitution. In this connexion I must admit to a certain amount of unease at the title of this Symposium, for "Provision of Laboratory Diagnostic Services" seems to lend support to this idea that the laboratory is there to provide a diagnosis.

The man on the spot must make the diagnosis on the basis of all the evidence available; some of this may be from laboratory findings and it may even be conclusive, but he must assess it in the light of his other findings. Conversely, if laboratory methods are to yield their full value the man who is responsible for their performance is entitled to the right material for investigation and all the relevant information about it. You will forgive the heartfelt cry of one who has suffered in his day from a lack of both. Most laboratories undertaking routine work can provide daily examples of specimens badly packed, the wrong organs sent for toxicological examination, specimens in formalin for bacteriological examination, unpickled tissues in air-tight tins for histology, and, terse notes such as "please examine." I know that the consignees also have their grievances varying from long delayed reports, to reports so non-committal or couched in such specialist jargon as to be useless. I merely remind you that the exasperations are not all one-sided.

At this stage I shall not discuss the adequacy of our present facilities, except to restate briefly the findings of the B.V.A. Laboratory and Ancillary Aids Sub-committee who said that there is an urgent need for an expansion of the Veterinary Investigation and Advisory Services and a serious inadequacy of facilities for small-animal practitioners.

Assuming that there is general agreement with these conclusions I wish to draw your attention to what will be some of the problems in any expansion. Money, buildings and equipment can be found if the will is there, but what about the men?

Manpower

The increasing variety and complexity of laboratory methods calls for a training over and above that provided in the undergraduate veterinary curriculum, and the laboratory services need men with some degree of post-graduate specialist training. A post-graduate diploma course in the basic principles of applied and clinical pathology may well be called for and this type of instruction is best done in the veterinary schools. Broadly speaking the schools have tackled successfully the post-war problems of expansion and reorganisation of their undergraduate training: their next big problem must be an expansion of post-graduate teaching. However, this is partly related to the demand for it, and demand is also a reflection of the financial reward likely to be earned by those who undertake such post-graduate training. It is an ironic commentary on our sense of values as a community that the young veterinary graduate who increases his knowledge and expertise in some specialised field by post-graduate training, far from receiving some reward is, in fact, penalised financially in comparison with his colleagues in practice who are paid quite well while still relatively inexperienced. Certainly it is quite unrealistic of the Agricultural Research Council to expect young veterinary graduates to accept scholarship awards of about £500 per annum while their contemporaries can command salaries of £1,000 and upwards in practice.

It is, of course, difficult to dogmatise on hard and fast lines as to how this recruitment of specialists is to be solved, for I am willing to admit that their dearth is not entirely explicable in terms of financial reward. Nevertheless, I believe that some more tangible encouragement from the main employers of laboratory workers, namely the Ministry of Agriculture, Fisheries and Food and its Veterinary Investigation Service, the Agricultural Research Council and the research institutes would make a considerable difference. The possession of suitable post-graduate experience or training should be an automatic entitlement to assimilation at two or three steps at least up the promotion ladder. Alternatively, recent recruits could be seconded for post-graduate training to suitable teaching institutions for study leave on full pay.

In passing I must say that I am unconvinced that the present system of training recruits to the Veterinary Investigation Service by stationing them at the Central Veterinary Laboratory at Weybridge for a few months before posting them to a centre is satisfactory. I believe a more formal training is needed in the basic principles of clinical veterinary pathology, and this would best be done in the veterinary schools; but the Veterinary Investigation Service would have to recognise and reward such post-graduate training in a tangible manner.

No outline of the manpower problems would be complete without pointing out that professional staffing must be supported by technical staff adequate both in competence and numbers. The shortages of technical staff are as serious as those of professional staff and are further complicated by the fact that our technical staffs may also find employment in the

National Health Service whose rates of pay are often more than competitive.

I have dealt at some length with the manpower problem because, in my opinion, it is much the most serious of those we have to solve if we are to expand our laboratory and advisory facilities.

However, it would be wrong to give the impression that there are no other difficulties to surmount.

Finance

Inevitably any extension of laboratory facilities will need financing, and the capital and recurrent costs of laboratories can be formidable items of expenditure. An expansion of the Veterinary Investigation Service will entail the provision of public money, and the Treasury will only be susceptible to arguments which show that such expenditure will increase agricultural efficiency. My personal opinion is that this country will sooner or later, probably sooner, have to enter into much closer political and economic links with the European community. Speaking economically this is viewed with great misgiving by British farmers, but I think they will have to face it and, whatever the detailed arrangements are, they will have to be more competitive *vis-à-vis* their European counterparts. At the risk of being tedious to our farming friends it must again be emphasised that one of the biggest causes of livestock farming inefficiency is disease, and the greater use of veterinary advice backed by laboratory facilities will be a direct contribution to increasing efficiency. Farming opinion fears a flood of agricultural products into this country, but this is not inevitable. It may even be that in certain fields we may be able to expand our own agricultural markets abroad. For example, the rapid expansion of intensive poultry production may well result in the export of poultry products to Europe, and changes in animal husbandry patterns in other forms of stock keeping may result in our farmers becoming serious competitors for markets beside our own internal one. Veal production and even broiler rabbit meat could find continental outlets. However, the disease situation will need constant investigation if we are to keep abreast of the new problems which will inevitably arise with such new and intensive methods.

While I believe that the country in its own interest should finance the machinery for laboratory investigation of these problems, we must also acknowledge that certain laboratory procedures of a routine nature are of immediate help to the veterinary surgeon and benefit to his client and that it would be reasonable for them to be charged for. It is my own view that the completely free service now given by the Ministry of Agriculture, Fisheries and Food through the Veterinary Investigation Service shields the farmer and, to some extent, the veterinary surgeon from a true appreciation of the cost and value of laboratory help. A willingness to pay for some of the service might make it easier to persuade the Government on the need for its expansion.

Small-animal Facilities

From the evidence we obtained from practitioners it is perfectly clear that there is a definite shortage of laboratories providing facilities for small-animal practice. The Veterinary Investigation Service, by its terms of reference, only examines material of agricultural importance and the veterinary schools are reducing their routine laboratory commitments. (I will refer to the attitude of the schools in this matter in due course.) As a result of this we have a situation where large conurbations such as the Birmingham, Manchester and Tyneside areas are without any small-animal laboratory facilities at all. Densely populated areas such as the West Riding and South Wales are equally badly served. This is a serious gap in our professional services, and it cannot be met by one or two centrally placed laboratories such as the Canine Health Centre of the Animal Health Trust. The responsibility for small-animal care will, as far as one can see, always be on a private basis and the state is unlikely ever to provide support for it except possibly in certain limited instances of public health import. This being so the solution to our laboratory problems in the small-animal field will have to be found by ourselves.

It is one of the strengths of a relatively free economy that it allows scope for the enterprise of the exceptional individuals to try out new approaches to problems of organisation and this is true of our own profession. There are a few practitioners who are developing, or have developed, their own laboratory facilities; some are limited to their own practice, others are willing to do work for other veterinary surgeons. The success of these private enterprises is of considerable importance to us all for it could point the way to one method of solving some of our laboratory problems. It may well be that the creation of group laboratories, financed and supported by a number of co-operating practices would be a practical and feasible means of providing laboratory facilities in areas so in need. It is possible that some of these laboratories might be part of a group hospital unit.

Another approach, and I stress that I do not regard it merely as an alternative, would be the sponsoring of some laboratories for small-animal investigations by the animal welfare societies. In the changed economic conditions of to-day it is, to say the least of it, doubtful if there is a need for extensive charitable machinery to provide free services which the majority of people can afford to pay for. This is particularly true of the continuing urge of some animal welfare societies to establish clinics for the free treatment of the animals of the poor. The average practising veterinary surgeon has always been willing to undertake the treatment of animals of those unable to afford it and this willingness, coupled with some voucher system, is adequate for looking after the small minority of really poor people. Nevertheless there are still fields of activity waiting for those societies sincerely concerned with the welfare of animals. Strategically placed laboratories, founded and supported by those societies would fulfil a real need in animal welfare, and with a public increasingly educated to the scientific approach be sure of popular appeal and support.

(*Concluded at foot of p.* 1188)

2.—Structure and Availability

BY

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Introduction

SUMMARY.—Diagnosis laboratories are identified and their varying availability discussed. Distance is the chief factor limiting the availability of any laboratory for other than special examinations. Suggestions are made about ways in which laboratory services might develop, as a basis for discussion.

As Professor Hughes has indicated, the review of the use of the various types of laboratory service available to the veterinary surgeon in practice has shown that the bulk of the material sent for laboratory diagnosis goes to the Veterinary Investigation Centres of the Ministry of Agriculture, Fisheries and Food and of the Department of Agriculture for Scotland. There are many reasons for this, and it is the purpose of this paper to examine these reasons in order to give some indication of the way laboratory diagnostic services will need to be developed, if their development is regarded as essential to the future efficient functioning of the profession.

Structure

First of all it is necessary to enumerate the laboratories which, to a greater or less degree, supply a veterinary laboratory diagnostic service. In Great Britain and Northern Ireland they are:—

Veterinary Investigation Centres (England and Wales)	18
Veterinary Investigation Centres (Scotland) (including 2 sub-centres)	6
Veterinary Research Division Laboratory (Northern Ireland)	1
University Departments	6
Animal Health Trust Laboratories	4
Commercial House Laboratories	5
Private Laboratories	3
Total ...	43

Introduction.—*Concluded.*

The Role of the Veterinary Schools

From the investigations of the Laboratory Subcommittee it was clear that the veterinary schools were reluctant to provide extensive routine laboratory services. Three of them took the official position that they undertook no routine laboratory investigations, although it is known that some work of this nature is done by arrangement with individual veterinary surgeons. The other schools have restricted or are trying to restrict such commitments. Certainly none of the schools is prepared under the present circumstances to expand its routine laboratory services. This attitude needs explanation, especially to the older generation of veterinary surgeons who habitually looked to the schools, particularly their own, to help them in their laboratory problems. The schools are all now within the university structure and quite properly they are imbued with the outlook that their main purpose is the training and education of the student and the advancement of knowledge. The later requirement means involvement in research, and research to-day, in whatever field, has become so complex in its techniques that it requires great devotion of time and energy. This is particularly difficult for the teacher who also has his primary commitment to training his students. Any considerable involvement in routine work must be to the detriment of effort which should be on teaching and research.

It must also be pointed out that universities are not prepared for their staffs or financial resources to be extensively engaged in routine activities of this type. Young veterinary teachers, apart from their personal inclinations, are aware that their progress and promotion will, to a considerable extent, be governed by their contributions to new knowledge. Routine laboratory investigations such as are needed by clinicians are not likely to provide these opportunities on any great scale. However, having made these points I must not leave you with the impression that the schools are not aware of the value of such routine investigations, both as a source of teaching material or as the start or basis of research projects. They are also excellent for training the young laboratory worker in techniques. The problem is to control the flow of such material so that it does not dominate the laboratory and the individual's time, so that apart from his teaching there is no time for research. Although the schools will always undertake some of this work for the above reasons, it is also clear that they are unlikely to solve the problem of providing the laboratory facilities we need as a profession. The proper rôle of the veterinary schools in this connexion will be to provide post-graduate instruction in laboratory methods, so that the appropriate laboratory centres are manned by veterinary staff adequately trained in the basic principles of clinical pathology.

It is clear that our need for laboratory facilities is fundamental if we are to provide an effective professional service to agriculture and the animals of this country and, furthermore, our needs in this field are going to expand. I have endeavoured to sketch the extent of these needs and I hope I have drawn attention to some of the problems involved in expansion of laboratory services.

I must now leave it to my colleagues to go into greater detail of the particular aspects of the overall problems.

In addition to the above, there are several laboratories attached to general practices, which supply a diagnostic service to other practices in their area, but details of these are not known.

Veterinary Investigation Centres (England and Wales)

These laboratories are a part of the Ministry of Agriculture Animal Health organisation, and the Veterinary Investigation Officers in charge of the laboratories are responsible to the Director of Veterinary Laboratory and Investigation Services through one Deputy Director, stationed at Weybridge, and one Superintending Veterinary Investigation Officer, stationed at Cambridge. In effect these laboratories are branches of the Central Veterinary Laboratory, Weybridge, and there is a close degree of co-ordination. Each laboratory is staffed by 1 Veterinary Investigation Officer, and from 1 to 3 Assistant Veterinary Investigation Officers, with a senior technician and a varying number of scientific assistants and laboratory attendants, this latter number being dictated largely by the quantity of diagnostic work being handled at the laboratory.

Veterinary Investigation Centres (Scotland)

The 3 original centres are the responsibility of the Department of Agriculture for Scotland and are situated at the East, West and North of Scotland Agricultural Colleges with which their work is generally associated, and where specific teaching duties are carried out. Although these centres co-operate closely in national schemes with the English and Welsh service, they are a separate organisation, their work being co-ordinated by the Deputy Chief Veterinary Officer of the Ministry of Agriculture stationed in Edinburgh.

Recently a new centre has been established at Perth. Sub-centres exist at Inverness and Oban.

Veterinary Research Division Laboratory (Northern Ireland)

This laboratory, which is part of the Ministry of Agriculture for Northern Ireland, gives a complete laboratory service to practitioners in the 6 counties as well as doing basic research and production as a Central Veterinary Laboratory.

University Departments

The 6 university veterinary schools in Great Britain have extensive laboratory facilities in their various departments. The use to which these are put is the responsibility of the Heads of these departments, but no specific diagnostic laboratory facilities or staff are available at any university.

Animal Health Trust Laboratories

These laboratories, under the overall supervision of the Scientific Director of the Animal Health Trust, are divided on a species basis and provide diagnostic facilities for equine, canine, farm livestock and poultry cases. The poultry laboratory is the joint responsibility of the Agriculture Research Council and the Animal Health Trust, the other 3 being the entire responsibility of the Animal Health Trust, which is financed from private sources. There is in each case a Director who controls a varying number of professional and technical staff.

Commercial House Laboratories

Five commercial houses provide appreciable diagnostic facilities but in the main these are used in connexion either with investigations concerning their own products or in routine examinations for their customers, again in connexion with their products. Other houses have, of course, considerable laboratory facilities, but these are not available for diagnostic purposes, other than in exceptional circumstances.

Availability

This heading covers a number of factors which condition the quantity and nature of the work done, and again this is best done under the headings of different organisations.

Veterinary Investigation Service (England & Wales)

By their terms of reference, the work carried out by the Centres is limited to work on farm livestock, and the only animals of the domestic type dealt with are working farm dogs and cats. All cases are handled through veterinary surgeons in practice, with the exception of poultry and rabbits, where the owner may be dealt with direct for payment of a fee, recently adjusted to a more economic level. Where farm animals are concerned the purpose of the Centre is to aid in the diagnosis of outbreaks of disease, and is not, in general, concerned with disease of individual animals. There are obviously occasions when this latter point needs interpretation, such as in the diagnosis of Johne's disease, or of metabolic upset, but it should be interpreted in the view of the likelihood of animal-group involvement.

Within the above broad limitations, the Centres undertake, or arrange for, laboratory examinations of all practical types, on material sent in by veterinary surgeons in practice. The availability of the various types of examination varies, usually at the discretion of the laboratory staff, and for this reason the closest collaboration between laboratory and practising veterinary surgeons is essential. To give examples, laboratories not infrequently receive material with a general request for toxicological examination, without any indication of symptoms shown or possible lines of enquiry. Complete forensic analyses are not possible except in highly exceptional cases, but individual chemical examinations can be quickly carried out if symptoms or circumstances point to a particular poison. Similarly it is not unknown for samples to be received with a request for general bacteriological, parasitological and chemical examinations to be carried out, without any indication as to why it was impossible to narrow the field by clinical examination. These two examples are exceptional, and happily increasingly so, but Professor Hughes's view that laboratory examinations are only an aid to the establishment of a diagnosis cannot be too strongly endorsed. Their usefulness is limited by the amount of clinical history presented with the material, and further, the limitations of all the tests should be fully understood by all concerned.

Practically all laboratory test results need interpretation in the light of all circumstances, and generally speaking the laboratory worker should be in a position, when reporting results, to give his assessment taking into account his expert knowledge of the tests involved and the history provided by the veterinary surgeon. Furthermore, the question of the availability of some of the rarer and more expensive techniques must be answered by the head of the diagnostic laboratory unit, in full knowledge of the circumstances, as his is the responsibility for the disposition of the resources of the laboratory. These aspects of availability are now very widely understood, and in the overwhelming majority of cases a good relationship between practising and laboratory veterinary surgeons has been established, with mutual benefit.

Another aspect of availability is the distance of the practising veterinary surgeon from the laboratory. In 1955 an analysis was made of the material received at V.I. Centres, and the results for the Reading V.I. Centre, which may be taken as an example, show some revealing figures. This centre serves 5 counties, of which Northamptonshire is the biggest in terms of stock population, and extends from 50 to 110 miles from the Centre. Only 6 per cent. of all material received came from this county. Figures analysed on the basis of distance of practice from the laboratory showed that 66 per cent. of samples came from practices within a radius of 30 miles, and 98 per cent. of samples from those within 60 miles.

These figures are conditioned somewhat by the different density of veterinary practices, and by the shape of the area served, but they do not vary much from the national ones, and it is generally agreed that from 50 to 60 miles is the maximum distance over which a laboratory can give effective service. Within this distance farmers are usually willing to deliver carcases or material where they think they will benefit by the journey. Beyond this distance, the arrangement of public transport and postal services dictates whether or not a useful service can be given. These figures show that where laboratory services are available they are used, but that when not easily available they are less frequently used, and it should be added here, to the expressed regret of both sides.

Charging for laboratory services is another conditioning factor. In the main the services of the Veterinary Investigation Service are free, with the exception of some charges for market or export certificates, for examinations for which the practitioner is already paid, for some purely routine examinations, and for poultry examinations. The author is not in a position to discuss the case for charging, but in this context would like to make two points. Firstly, this service is in effect part of the agricultural subsidy system, and no farmer is debarred from using it for financial reasons; in fact the smaller farmer is the one who should benefit most. Secondly, no laboratory service is a one-way operation. The collection of information on changing trends in animal disease, the identification and evaluation of new or changing conditions, and the supply of material from the field to research workers and teachers are all equally valuable parts of the work of a diagnostic laboratory. This should be borne in mind when any system of charging is discussed, as any such system would probably distort the picture, as seen from the laboratory.

Veterinary Investigation Centres (Scotland)

The conditions are essentially the same as for the English and Welsh centres. It would appear that distance of practices from the Centres can be greater, with consequent loss of availability.

Veterinary Research Division (Northern Ireland)

The conditions are basically the same as above, but no details are available concerning availability over a distance. The numbers of livestock in Northern Ireland are comparable with those in an area covered by one of the larger English veterinary investigation centres, and as the distances from the laboratory to the furthest points are comparable, availability would appear to be about the same.

Animal Health Trust Laboratories

The availability of these laboratories for diagnostic purposes is limited to material from the species in which they specialise. In general there are no limits on the amount or type of material received. Distance is obviously a factor in regulating the amount of work received, all the laboratories being stationed in eastern England. Their diagnosis service is available to all veterinary surgeons, but they are basically research institutes which cannot deal with a large amount of diagnostic material. Were there more such laboratories distributed over the country obviously greater use would be made of their services. Charges are made, varying between the laboratories and according to circumstances.

All examinations are carried out for veterinary surgeons, with the exception that the Poultry Research Station carries out examinations for farmers, and on behalf of feedstuffs manufacturers.

Commercial House Laboratories

As only 5 of these handle appreciable quantities of diagnostic material and as each company has only one laboratory, geographical limitations are again apparent.

None offers general diagnostic laboratory facilities. In most cases the examinations are carried out on problems related to the firms' own products, or as a service to their clients. In most cases the examinations are done for veterinary surgeons in practice, or in extension of the work of the company's own veterinary staff. In some cases, fees are charged for examinations. Poultry examinations are carried out for farmers by some firms, but most feedstuff firms use other laboratories for this service, on a fee-paying basis.

Private Laboratories

Of the 3 private laboratories of which anything is known, 2 provide diagnostic services for veterinary surgeons on an economic fee-paying basis, for all species of animals, but mostly in connexion with small animals. The third private laboratory concentrates on poultry and other birds, a service being

given to owners and to certain commercial houses on a fee-paying basis. All 3 engage in the production of both standard and autogenous vaccines. This latter activity is not, of course, conditioned by distance, and supplies a demand not readily satisfied by other laboratories.

University Departments

Laboratory diagnosis facilities are not freely available at any university. Speaking in general terms it may be said that the service available is limited to the amount necessary to obtain teaching or research material. This limitation may be on a geographical or personal basis, but teaching and basic research have priority on time and material. This being so, other limiting factors, including distance, become insignificant. It would seem that, always remembering that teachers should have free access to material and information from the other laboratory services, the universities are unlikely to play any part in any expansion of laboratory services in this country under present conditions. They will play an increasing part in the consultant side of the profession, but this symposium is confined to laboratory services.

General Discussion

From the above details of structure and availability of all the laboratory services in this country, it would appear that any expansion which may be required will probably have to come through the 3 Government services in the United Kingdom and Northern Ireland, through the Animal Health Trust or through an increase in the number of private laboratories. Taking into account the limitations which have been stated, the best results would be obtained if a diagnostic laboratory were within 50 miles of every practice in the country. It is obvious that there are some areas where this is not practicable because of small numbers of livestock and consequently of veterinary surgeons, but it would seem to be desirable for most parts of England, Wales and Southern Scotland.

If this is accepted, the profession is faced with staffing extra laboratories as well as maintaining and increasing the scope of the existing ones. It is obvious that we require some form of post-graduate education to supply recruits for this increasing type of work. The discussion of this is Professor Weipers's responsibility.

Increasing specialisation is an obvious future tendency in the development of the profession. The laboratory investigation worker has established a rôle as a specialist within the profession, and he needs certain differences in outlook and temperament from those of other workers, including university teachers, pure research workers, and practitioners. It is important, therefore, that not only should suitable people be recognised early but that suitable career prospects should be offered in this particular field. As Professor Hughes has mentioned, promotion of workers within universities and research institutes depends a great deal on their contributions to new knowledge. The great amount of new knowledge which has been obtained for our profession by the diagnostic laboratories over the last 15 years should not be overlooked, but it is a fact that workers in diagnostic laboratories cannot be expected to carry their research very much further than the establishment of the fact that a new condition exists or that an old condition has changed. Once this fact is established, it is difficult for the worker in a small laboratory to carry on with the more detailed research required, and consequently much of the new knowledge gained by the diagnostic laboratories is not fully processed for publication before it is passed over to full-time research workers as a specific problem. Consequently, a laboratory diagnosis worker may not be able to develop the same level of publication as those engaged in other academic establishments, although in his way he has contributed as much to new knowledge. This should be recognised in order that younger members of the profession should not be deterred from joining this branch because of fear that fewer publications will put them at a disadvantage compared with other academic workers.

The need for specialisation within the laboratories is becoming apparent and the main discussion is on whether specialisation should be carried out on a species or a discipline basis. While the idea of a team comprising specialist bacteriologists, pathologists, parasitologists and chemists is attractive, such a team requires a co-ordinator and the whole question of career prospects and training comes into the matter. A moderately deep knowledge of all the disciplines applied to a single species of animal would appear more likely to produce balanced results at the level of the diagnostic laboratory. Striking the balance between the disciplines has been, and always will be, a problem in scientific establishments of any sort, and since divisions on discipline lines are essential at research institutes it seems preferable that the specialists at diagnostic laboratory level should be of a different nature.

It is possible to envisage several compromises between the 2 alternatives. The following ideas represent in no way official policy, and are put forward in order to stimulate discussion on this important aspect. One alternative is an evolutionary development of the existing loose-knit system, whereby material is dealt with on a species basis in investigation centres, and specialist advice on a discipline basis is sought where it may be found, be that any institute or university in the country, but chiefly from the Central Veterinary Laboratory, Weybridge. The advantages lie in workers in institutes having access to field material at will, and in keeping investigation workers in direct contact with institutes. The disadvantages are that willing research workers and teachers are sometimes overloaded with diagnostic material to the detriment of their other activities, and that this type of liaison can be very patchy and unreliable from the investigation worker's point of view, particularly with an institute outside his own service.

In order to overcome the disadvantages of this system, it would be necessary to evolve a system wherein discipline specialists are employed primarily on investigation work. This could take the form of a special department at Weybridge to assist the Veterinary Investigation Centres, or alternatively of enlargement of 4 or 5 Centres to accommodate the

discipline specialists, these enlarged Centres to service other Centres in the area.

This latter alternative has certain attractions in creating regional centres completely self-contained for all laboratory diagnostic procedures. Such centres would overcome some of the disadvantages of the present system. Not least of these is the difficulty of supplying a continuing specialist service when a particular specialist in a particular laboratory is absent on leave, sick leave, conference leave or study leave. A close-knit regional organisation geared to the tempo of diagnosis work would overcome this difficulty more easily than any centralised system. It would speed up, by the nature of its organisation, the reporting of results of most laboratory examinations, and speed is the essence of all diagnostic work. It could be argued that a special central department would also supply the speed. This is quite true, but if the work were split between several laboratories, an efficient system of reporting results by telephone could be evolved in the smaller area covered. Teleprinter facilities are already available at many Ministry of Agriculture establishments, and this might make an acceptable alternative. Other advantages of the regional system lie in the closer association between the workers in investigation units and the discipline specialists, and *vica versa;* in closer collaboration of investigation workers in research work at the larger units; in making more available the services of consultants on the disciplines in the area; and in placing control of all diagnostic laboratory procedures in the hands of people with no other commitments. The disadvantage lies chiefly in removal of contact between research workers and the field, and between investigation workers and the institutes. A centralised diagnosis department would have the same disadvantages. A liaison would nevertheless be built up to overcome this, a liaison based on wish rather than necessity.

The latter 2 alternatives face the fact that laboratory diagnosis, for want of a better phrase, is a special discipline, and meet its requirements in an organisation which contains all the elements necessary to its proper functioning.

The first part of this discussion has concerned itself with the official laboratories. Any expansion of these depends on the means being made available. Should they not, the expansion must come from elsewhere. The Animal Health Trust could well expand its activities given the means, but in a small profession with limited resources duplication of services is undesirable, although some freedom of choice should be left. Consequently it would be preferable for the Animal Health Trust to supply a laboratory service complementary to the existing Veterinary Investigation Service, not in competition with it, other than through its existing laboratories which have a high reputation. Obvious fields for expansion are those of equine, poultry and canine diseases, in particular the latter. The most urgent need is for small-animal laboratories in the large conurbations, and the Trust seems to be the organisation best qualified to supply these. It is difficult to envisage the means being found for country-wide laboratories for farm livestock, provided by the Trust alone, but should the means for expanding the official laboratories not become available, some action by the Trust to expand might be encouraged, either alone or in association with other organisations.

Turning to private laboratories, it is difficult to envisage a nation-wide chain of private laboratories giving a comprehensive laboratory service and indeed it is probably economically impossible in view of the high costs of such a service. It is possible, however, to envisage the development of practice laboratories capable of carrying out the more simple and less expensive examinations for a single large practice, or a group of smaller ones. This would not only be more speedy, but would also take out of the bigger laboratories a large amount of work taking up the time of people skilled in the more advanced techniques. There are dangers in this system, the chief one being the employment of either untrained or over-assertive technicians. The training of technicians is a most important matter, and we should recognise that the Institute of Medical Laboratory Technology stipulates 5 years as the minimum period of service in a recognised laboratory before candidates may sit for their final examination. The profession owes a lot to the I.M.L.T. for establishing high standards for its qualification, thereby improving the quality of work done. It is worth recalling that one of the two founders was Mr. Norman, Chief Technician at Weybridge till his retirement some 10 years ago. In any development of private laboratories, recognition of the standards of this Institute should be made, as it has been by the state laboratories. Apart from the development of laboratories at practice level, there will always be a place for private laboratories, but probably in special fields, such as in small-animal work, in poultry work, in production of autogenous and other vaccines considered uneconomic in commercial firms, and in cases of individuals whose special knowledge and attributes outbalance the disadvantages of distance.

The possible future developments in other organisations have not been dealt with because of inadequate knowledge of intentions or resources. It seems unlikely that the universities or commercial houses will enlarge their diagnostic facilities under present conditions. Any expansion in these categories in the future would obviously have geographic disadvantages, and could not adequately cover the country, but it would perhaps be an advantage to have some alternative laboratories available to the profession.

Conclusions

A need having been shown for more diagnostic laboratories, it seems probable that this need could be met by, at the most, 6 more laboratories of the Veterinary Investigation Centre type in England and Wales alone. It is desirable that the laboratories should provide an attractive career to the right kind of veterinarian, and that an adequate post-graduate course should be available to educate him in laboratory methods. The laboratories seem likely to evolve towards a more specialist type of structure. The nature of this structure requires debating, and suggestions made in this paper are put forward as a basis for discussion.

3.—The Training of Professional Staff

BY

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SUMMARY.—Having accepted the need for laboratory assistance in diagnosis in modern veterinary practice, I have stressed that the post-graduate training should be related to the type of work the veterinarian will carry out later, namely, the establishment of diagnosis in conjunction with the practitioner in difficult disease problems in herds and flocks. In stressing the diagnosis component I am not presuming that these workers will not give advice on how to deal with the problem that has arisen, but this is by far the simpler part of the problem because any rational advice depends on the current state of knowledge in the subject under investigation. The plea is made that a post-graduate qualification should be evolved, probably at one or two of the universities, specially tailored for V.I.O.'s and it is stressed that such a course would also be useful for people coming from the developing territories throughout the world.

Introduction

I HAVE been given what I consider to be a fairly difficult task, namely, to suggest a course of training for workers in a hypothetical laboratory service which has yet to be designed. What I think the organising committee had in mind, when I was invited to contribute to the discussion, was that I should give my views on how new entrants to the V.I.O. service should be trained. There is a growing conviction that some form of university post-graduate training would be useful for this purpose and it was no doubt thought that I would suggest a suitable curriculum for such a diploma.

On all the available evidence I think it is a reasonable assumption that at least some part of a laboratory service for the profession will be developed in connection with the Veterinary Investigation organisation of the Animal Health Division. Before I discuss the training of workers, I feel it is essential to discuss some factors which would be of paramount importance in the development of laboratory facilities to help with diagnosis.

The Need for Laboratory Service

I should say, at the outset, that I accept the necessity for laboratory assistance in diagnosis in the veterinary field. The very great advances in medical science render it inadvisable for even the most competent clinician to depend purely on clinical examination for diagnosis in all the problems he will meet in his daily practice. I accept that a very large number of cases can be diagnosed on purely clinical grounds but a proportion can be resolved only with laboratory assistance. It is not unusual for the presence of some obscure disease condition in an area to be established in the first place with the assistance of a laboratory service but often on its reappearance at a later date it can be recognised on clinical grounds alone. This has been the usual pattern in medicine since the introduction of ancillary methods of diagnosis. Laboratory methods improve clinical competence by translating speculation into knowledge by repeated confirmation of the significance of the presence of clinical or *post-mortem* patterns or syndromes. Major advances in laboratory methods ancillary to diagnosis have taken place in the lifetime of many veterinarians in practice to-day and many have been quick to see the advantages of this type of approach. I accept the old dictum that diagnosis is often a matter of coming to a conclusion on insufficient evidence, and to me the corollary to improved diagnosis is not that one should assiduously practise divination but that one should produce as much additional evidence as possible.

I am sure I am talking to the converted when I stress the paramount importance of laboratory methods. Who would go to the stake on the veracity of a diagnosis and prognosis made purely on clinical grounds in cases of, for instance, tuberculosis, cobalt deficiency, cirrhosis of the liver, nephritis, pancreatic disease, to mention only a few conditions, where accuracy of diagnosis can be improved a hundredfold by relatively simple laboratory methods using, for instance, microscopy (dark ground illumination in leptospirosis), bacteriological, chemical, biochemical and serological methods?

The main need for a laboratory service is in relation to diagnosis.

The Present Position

There is, at present, an acute shortage of laboratory services available to the practising veterinary surgeon.

It is probably only the clinicians working in the veterinary schools who have had a full opportunity of exploring what can be done in clinical work with a comprehensive laboratory service, including facilities for pathology (morbid anatomy and histopathology), bacteriology, virology, mycology, biochemistry, haematology and biopsy. With such assistance it is possible to improve manyfold the accuracy of diagnosis in difficult cases, either in individual animals or in the study of outbreaks of disease in flocks and herds.

At the veterinary schools there has been an acute realisation of how time consuming is this type of detailed investigation. I am afraid we have sometimes disappointed our colleagues in practice in that we have not developed comprehensive laboratory services which would be available to them. To have done so against the background of limited resources would often have interfered seriously with our primary teaching commitments and would certainly seriously have impaired our ability to study some of the problems of disease urgently requiring investi-

gation. Thus this source of laboratory assistance to the profession is relatively meagre considering the over-all demand.

Private Laboratory Services

Some practitioners, convinced of the value of laboratory methods, carry out sideroom tests using lay assistance. Others use trained technicians but this latter source is only possible in a large practice. The procedures covered range from examination of skin scrapings for parasites, or fungi, bacteriological and parasitological examination of faeces and urine, haematology, microscopy and chemical examination of urine, to more complicated tests associated with the estimation of blood urea and certain types of enzymes, and liver function tests. This type of testing is not normally supplied by the V.I. Service where disease applies to an individual animal and, if such a service is to be fully developed within the V.I. Service, it would entail a three- or fourfold increase in manpower.

The Animal Health Trust provides some services but these do not give a nation-wide cover.

One or two laboratories undertake examinations for veterinary surgeons in practice on a fee paying basis but this type of service, as organised meantime, can deal only with a very small part of the problem.

Veterinary schools give some laboratory service but it is usually limited, being related to some problem which is being investigated at the time.

The Organisation of Laboratory Services

I have deliberately referred to "services" because I am sure that the need will not be met by one service only. In discussing the part that will be played by the V.I. organisation in a laboratory service it is clear that any discussion on training will be conditioned by the structure of the service. There should be no facile assumption that the type of Public Health Laboratory Service in use in human medicine can be used as a pattern for the veterinary profession. This is not because the type of work that is done in human medicine has no counterpart in animal health. Indeed, some of the problems in the zoonosis in which the Public Health service may be interested may arise from either an animal or a human patient and, even at the present time, conjoint investigation of problems of this nature are frequently undertaken. Members of the Public Health Laboratory Service are particularly interested in a limited number of infections, bacterial or virus, many of the type that are dealt with in veterinary work by the field officers of the Animal Health Division of the Ministry of Agriculture as Scheduled Diseases under the Diseases of Animals Act. This still leaves a considerable problem in bacterial and virus diseases which may occupy a large part of the veterinary laboratory service but it is important to remember that the problems on which this service is consulted may be associated with parasitological, biochemical, nutritional, metabolic and genetic factors, and with diseases arising from animal husbandry conditions. Thus the training must be wider than that given to the members of the human laboratory service. While it is not unreasonable to expect government help in a great national industry like agriculture, by undertaking research into animal disease problems that are widespread, it is unlikely that any government will provide, at considerable cost, a free comprehensive service for the investigation of disease in individual animals owned by farmers engaged in private enterprise at the request of the veterinary surgeon who is, in turn, employed by the farmer to look after such cases on a fee paying basis. Fortunately only a relatively small number of cases in practice require laboratory assistance in diagnosis. In practice, precise diagnosis is not necessary in the less serious diseases and veterinary surgeons, and, indeed, medical practitioners, in most of their contacts with the public, are concerned with shedding their patients into 2 groups, the first containing about 90 per cent. where recovery will take place in any case without treatment or with well established specific treatment, and the remainder where the practitioner realises that the case may not be simple and a policy of laissez-faire may have repercussions, either because the patient may die unless treatment—probably of a specialised nature—is carried out or some serious disease, infectious or otherwise, may become established. Steps are usually taken in such cases to call the assistance of specialists and full use is made of laboratory methods. As long as veterinary practice remains largely a private concern, I think it will be necessary for the profession to provide some laboratory facilities for individual cases. It might be argued that the V.I.O. laboratory is the most reasonable place to develop such a service but I feel that only an enormous expansion could cope with the demand and so many anomalies would arise in relation to costing that the whole matter could become unworkable. Furthermore, a laboratory service for the small-animal side would still have to be provided.

I would hope that the V.I. Service would be occupied, in the main, with the study of animals and material arising in the course of diseases of herds and flocks of animals and would be an integral part of preventive veterinary medicine and thereby make an important contribution to animal productivity and to the livestock industry. There does not appear to me to be any objection to a government department providing this kind of service which makes a contribution to the national herd, especially in an industry like agriculture where the principle of subsidy and the provision of research has already been established. Many industries provide their own research but the Government has accepted that it will carry at least some research in agriculture and, provided this service is related in the main to flocks and herds, then no situation arises whereby a government department is subsidising a private individual *via* a private veterinary surgeon who will charge him for that part of the service he gives from his own resources, and where the corresponding laboratory investigation properly costed might be greater than his own fee.

The present V.I. Service could probably be greatly improved if there were some regional grouping round a main V.I. Centre in an area serving 5 or 6 centres. This would permit of some devolution from the main central research laboratory of some

routine work at present carried out there and would also diversify the type of service in an area. In addition, it would provide senior people of experience within a region for consultation on disease problems.

The arrangements within a V.I. laboratory might apportion the work to the professional staff on a rotary basis, either on a species or on a discipline basis in relation to pathology, bacteriology, toxicology, etc. If this latter system were followed, then the field work would almost certainly have to be distributed on a species basis, probably again on a rotary system to cope with the problems which arise in relation to the husbandry of the individual species. The advantage of giving the individual members experience in each species avoids the danger of over-specialisation and every endeavour should be made to encourage the workers in the V.I. Service to keep their interests broad. From time to time, individual workers will show a particular predilection or capacity for a certain discipline and might be more suitably employed in the Central Laboratory. They would bring from the field a type of experience which would be complementary to the discipline specialists who had entered the laboratory with a different type of qualification, probaly postgraduate study at a university in a discipline leading to a degree within a narrow field.

In summary I would visualise that a laboratory service, probably limited to work on the diseases of herds and flocks, would be an integral part of the V.I. Service, and be available to members in practice. I have some doubts as to whether such a service would be expanded to cover the needs of the profession in relation to individual animals and it is against this background that I make my remarks on training.

The Place of an Organised Laboratory Service in Relation to the Profession

It is unreasonable to discuss the training of workers in a laboratory service unless one has a clear picture of the relationship of the service to the profession. We are a small profession even to-day, and most of our members are engaged in private practice. Specialisation has been developing rapidly over the last 10 to 15 years and, if we are to continue to make an important contribution to the livestock industry, the different sections of the profession must co-operate to provide a comprehensive service to the community. One of the most rapid developments within the last 10 years has been the growth of the V.I. Service and there has not been a clear definition of its place in the profession. At first it was ignored, now it is thought by some to be the panacea for all the ills of practice. The answer probably lies some way between these two extremes.

I think it would be profitable to study the arrangements at present available for providing a veterinary service in this country. The practising veterinary surgeon is the person who is in immediate contact with the farmer and is the first person who is consulted on disease problems that arise on his farm. It is my opinion that the present arrangement between farmers and veterinarians, which depends on the farmer calling the veterinarian on an *ad hoc* fee paying basis, is not by any means the most satisfactory way of utilising the full potential of the profession. If an arrangement could be devised whereby there was more emphasis on animal health and less on animal disease, and which would allow of the frequent presence of the veterinarian on the farm without the farmer feeling he was in the position of incurring additional expense on each consultation, benefit would accrue to the farmer. This is not, in any way, a new idea. The Survey Scheme, for instance, was based on this type of approach and contract systems have been employed, and are being employed, by a number of veterinary surgeons to this end. In any event, this type of change could not be affected overnight and many practitioners might well be at a loss to know how to make the fullest use of such a service. When presented with an important economic problem associated with animal productivity arising from disease, and whose solution depended on precise investigation of a subclinical disease, new methods would be required and use would have to be made of the laboratory service. Any such development would depend primarily on a good laboratory service based on a central laboratory where there were experts in the various disciplines. A laboratory worker in the V.I. Service in such a system would be a specialist, trained in aspects that would assist in establishing a diagnosis. The term "general specialist" which would describe his work may, at first sight, appear to be a contradiction in terms but this would be the nature of his speciality. To gain the maximum benefit from such a system some practising veterinary surgeons would require to reorientate their whole approach to practice. Teachers in the veterinary schools are, in any event, in varying degrees stressing the benefits which can be got by laboratory methods and many young graduates are already well equipped to utilise a good service of this kind in investigating outbreaks of disease. It is fairly clear that there will be many disease problems which would arise which the V.I.O. could not solve and where assistance would be sought at the enlarged regional laboratories. Many cases, in turn, would be referred to the central laboratory where it might be necessary to set up experimental work where the precise nature of a disease could be established. In other cases, the assistance of consultants who had specialised on a species or discipline basis might be of great value. The old concept that the veterinary surgeon in practice was capable of solving all the disease problems on which he was consulted is passing and there is a general recognition that many problems lie within the province of specialists. With the developments that have taken place within the veterinary schools, it has been possible for a number of people to specialise in certain disciplines. Other veterinarians in many spheres have specialised in the study of the disease of certain species, poultry, pigs, etc., and are familiar with the disease patterns and the relationship of husbandry to disease. These specialists are available for consultation in difficult cases and can make substantial contributions to the solution of obscure disease problems.

By close co-operation and by the utilisation of all the available services, our profession can make a very large contribution to the economy of one of our largest primary industries. This contribution would be out of all proportion to the relatively small number of veterinarians in the country.

The Training of Workers for a Laboratory Service

It is clear that I have accepted the general idea that at least a considerable part of a laboratory service for the veterinary profession is likely to be developed within the V.I. organisation and, thus, anything which is said in relation to the training of people for laboratory work must take into account the other activities in which they are engaged.

I do not visualise that workers in such a service would segregate themselves in laboratories and be preoccupied with studying specimens of faeces or the entrails of animals as selected by practitioners and submitted for diagnosis. Such a restricted laboratory approach would limit the contribution which could be made to precise diagnosis in obscure disease conditions. This can best be achieved by close collaboration between the clinicians and the laboratory workers. Such collaboration might be in a general way, from time to time, to establish procedures in given types of cases, but, in some cases, would be in a very intimate way in consultation in individual cases. This type of approach does apply at present in certain areas but it is a pattern which must be generally established if the fullest use is going to be made of a laboratory service. An essential prerequisite for its success is the closest collaboration between laboratory workers and clinicians. There must be no preconceived idea that the laboratory, *per se*, provides a diagnosis. In many cases the practitioner provides, on clinical grounds alone, a diagnosis and, in the same way, in certain types of cases, for instance anthrax, the laboratory can provide an exact diagnosis but there is a large area in between where cases can only be diagnosed satisfactorily by a combination of laboratory and clinical means. An isolated laboratory service would limit the opportunities for extending our knowledge of obscure disease conditions and would fail to define the detailed comprehensive pattern which is often present when disease occurs in herds and flocks and which requires the study of diverse factors, epizootiological, pathological, bacteriological, toxicological and metabolic and may arise because of faulty animal husbandry.

Training veterinarians beyond the undergraduate level in so many subjects presumes a different type of post-graduate training to any that is provided in our present post-graduate courses. In the main it differs in being much more general and the object would be to concentrate on those aspects of each discipline which will be helpful taken in conjunction with clinical findings in establishing a diagnosis in outbreaks of disease. This type of work is sometimes referred to as clinical pathology but this description means different things to different people and, in the medical profession, describes a totally different type of worker. It is generally accepted in educational circles that training can either be taken in depth in a few subjects or in breadth in a larger number, assuming the time factor is the same in both cases. My views on undergraduate veterinary education are well known and I think I can only briefly re-state them here.

The veterinary graduate must have, as a basis, a broad knowledge of animal husbandry and be familiar with domestic animals in health. The study of pre-clinical and para-clinical sciences has given him a broad understanding of disease processes and patterns and a scientific basis for his knowledge of clinical medicine, allowing him to recognise, diagnose and control diseases in animals. No matter what speciality a veterinary surgeon follows at a later stage, on completing his primary degree he should have sufficient clinical knowledge to allow him, as a result of a physical examination of an animal, and using such ancillary aids as may be desirable, to make an assessment of what is wrong and arrive at a diagnosis. Thus there should be an acceptance of the general nature of the undergraduate course and that specialisation can only be achieved by post-graduate training. Post-graduate training in pathology, bacteriology or biochemistry, etc., will usually take 3 or 4 years. Thus, any training for laboratory workers which occupies only 1 or 2 years must avoid depth in any one subject and be a broad general training. There should be a general recognition of this aspect and, obviously, a Veterinary Investigation Service, so constituted, cannot be the last court of appeal in difficult cases and in these will, in turn, consult other specialists.

I am interested primarily in the training of professional staff for V.I. Service but I would like to stress the necessity for sufficient numbers of adequately trained technicians and animal attendants to support the scientific workers. I am sure that formal training is important for these people and that they should study for a recognised qualification such as the I.M.L.T. or the National Certificates in biology and chemistry, etc. Only by ample provision of such staff is it possible to use professional staff economically.

I am assuming that the main professional staff in the V.I. laboratory service will be veterinarians, but I am sure that scientists with other qualifications, biochemical, zoological or general, can and do make a very important contribution within such a service. I would hope that in each of the larger Regional V.I.O. laboratories a qualified biochemist would be available.

What I have to say refers to the veterinarians likely to be employed in a veterinary investigational or diagnostic service rather than a laboratory service, *per se*.

None of the present post-graduate veterinary courses adequately covers the ground which would be suitable for a V.I. worker. The D.V.S.M. course is particularly well suited to the field officer in the Animal Health Division and the D.T.V.M. is geared particularly for the worker from overseas. Both these courses have components that would be useful to the V.I. worker but would probably only cover about a quarter of his interests. At first sight the Dip. Bact. or Dip. Parasitology diploma courses might appear to be the most suitable training because so many

problems in flocks and herds are associated with bacterial, viral and parasitic agents. Unfortunately any undue concentration on any one method of approach tends to limit the use that is made of what may be other equally important disciplines. Specialists the world over, by the very nature of their training, tend to be preoccupied with the criteria related to their own disciplines and are biased in their own subject. In some V.I.O. Centres, in the past, there has been a tendency to concentrate on bacteriological disciplines with a consequent loss of utilisation of other approaches. The end result was often some very good research work but it could be stated, in general, that the usefulness of a V.I.O. Centre for the purpose for which it has been created is in inverse proportion to its preoccupation with individual research projects. The V.I.O. must remain a general specialist whose major interest is the utilisation of laboratory assistance in diagnosis and any post-graduate training must be designed to this end. Specialisation in the case of the V.I. worker will rest solidly on his undergraduate training. In his case it must never become narrow but should be kept general and is concerned essentially with the application of a number of disciplines in relation to diagnosis of disease in animals. Thus, I am sure that the first stage for those who intend to enter the service is that they should spend a period in practice or at least undertake clinical work for probably a year. By so doing they will consolidate the instruction they have had in their veterinary schools, in clinical studies and apply these in practice. They will also become familiar with the problems of the practitioner in the field and they will also learn to appreciate the farmer's point of view. At first sight this may appear to be a loss of time but this type of consolidation is essential for anyone who wishes later to apply his clinical knowledge.

Opinion varies among V.I. workers on the stress V.I.'s should place on their approach to clinical work. Some have stated that they think it is of no value to them; others presume that this aspect should be left to the veterinarian in practice who consulted them; others think they should be as good clinicians as the veterinary surgeon in practice. My own view is that they should be competent clinicians but they can scarcely hope to be as good in this field as the veterinarian in practice whose post-graduate speciality has, indeed, been clinical work and who has spent his whole life in the clinical field. After his time in clinical work it would be beneficial to undertake formal study at a university veterinary school for a diploma with courses specially designed for his subject but, unfortunately, at the moment, no such course has yet been designed. The main theme of such a course would be a concentration on those aspects of a number of disciplines which are important in establishing a diagnosis. Such a study would cover morbid anatomy, histopathology and would lead into bacteriology and parasitology. Veterinarians will have studied these subjects in their undergraduate course and will have some knowledge of the diseases they produce but any formal course for V.I.'s will emphasise the significance of the importance of the pathological findings in relation to particular outbreaks of disease. Thus, ideally, the subjects of a course should be closely integrated and should include the training in the assessment of all the evidence from clinical, pathological, biochemical, bacteriological, parasitological and all other factors that may be available for scrutiny. For instance, it is easy to establish that a given number of parasites are present or that a certain potential pathogen has been isolated but it is a much more difficult matter to state whether these are responsible for the animal's death or were important factors in initiating or playing a part in whatever disease problems gave rise to the consultation in the first place.

I would like to see a course of study devised as a post-graduate diploma in a university veterinary school which would concentrate on those aspects that would be important to the V.I. Service. It may even be that the case method system which has been used in American universities, in industrial and in commercial courses of study, where actual cases and history records selected for formal study in class, could be used in the course. It would be necessary to give instruction on the interpretation and the information that can become available from the study of body fluids by biochemical, microscopical and physical means and discuss their limitations. The course would also include those aspects of animal husbandry which are important in relation to disease problems where feeding, management and other environmental factors may be responsible for clinical disease in herds and flocks. The course would have to be kept fairly general and would be based on the assumption that the main object of the laboratory service is to assist in diagnosis. If, in fact, a course were geared for the V.I. worker in this country, whose main interest would be laboratory work, it is clear that a course of this kind would have very great advantages to many workers in the overseas developing territories because many of the problems in the veterinary field in the emerging countries demand the assistance of a laboratory of this kind and most of the new states, colonies and mandated territories in Africa, provide a diagnostic service of this kind.

After completion of such a course the most important part of training would probably be related to applying the knowledge acquired in the organised periods of study by working in one of the larger regional veterinary investigation laboratories so that the trainee could acquire, under supervision, the special skills and techniques which have been developed in the V.I. Service. This could not be confined to bench work and would entail attendance with a senior person on routine visits, investigating outbreaks of disease in conjunction with the practising veterinary surgeon. The concept should be kept constantly in the foreground that the V.I. Service's main function is conjointly with the practising veterinary surgeon to establish diagnosis in difficult outbreaks of disease but this relationship, indeed, is only part of a much larger one which might entail consultation with the Central Laboratory, with clinical specialists and, on occasion, with field officers of

(*Concluded at foot of p.* 1198)

4.—The Veterinary Surgeon in Practice and His Need for Laboratory Services

BY

J. B. WHITE

Salisbury

FEW people will deny that veterinary science has made very great progress during the last 30 years. If one makes an attempt to analyse the advance it is interesting to try to pin-point the individual factors which have been instrumental in effecting this change. One's thoughts naturally turn to the person most intimately involved, the general practitioner, and one must admit that the young university graduate of to-day enters the profession with a far better basic training than was the case years ago. It is not, however, simply a matter of professional ability, for one has only to think of a few of the notable clinicians of the past to realise quickly that here were men of the highest calibre. Even men such as Motton of Penzance, Begg of Lanark or Brown of Invergordon, all of whom had tremendous clinical ability, were yet held in check because they were denied the facilities in diagnosis and treatment which we enjoy to-day.

Those of us who remember the introduction of the Veterinary Investigation Service in 1924 must recall with blushes the rather unfriendly reception which it received in some quarters. From very modest beginnings that service has grown to become an essential part of country practice, so that to-day it is difficult to see how one could carry on without its constant assistance in providing an essential component to the complete diagnosis of the case in the field.

When the history of agriculture in this country during the last 30 years comes to be written it will be seen that there has been an agricultural revolution during that period. The farmer has become aware of the great increase in production which can be attained by invoking the aid of science to help him control disease and parasites in both animals and plants, as well as by making the utmost use of intensive methods of production. The general increase in the output of animals and animal products has been accompanied by a general rise in their value which now lie well above their previous levels. It is not surprising, therefore, that the modern farmer expects and demands in large degree a veterinary service which will give him a specific diagnosis and treatment for his ailing animals.

Fortunately, our profession has been quick to meet this challenge, greatly assisted by the wide range of biological, antibiotic, and chemotherapeutic agents now available to us which becomes ever wider, bringing completely new lines of treatment and preventive medicine. Who would have thought a few years ago of being able to inject a drug subcutaneously in the treatment of parasitic gastro-enteritis, or of providing cattle with an active immunity against husk?

All these systems of preventive medicine and treatment have one common factor; they are relatively expensive and only give an economic return if used

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The Training of Professional Staff.—*Concluded.*

the Ministry who have responsibility for the control of the scheduled diseases.

I am sure that one of the most important aspects of post-graduate training is that recent graduates, even those who have completed their post-graduate training, should be attached to a fairly senior person for further training. The latter may delegate some of his responsibilities, but this method is the accepted one in every academic and other sphere where difficult techniques have to be acquired and applied in the field. It is only by this method that continuity of the development of method and new knowledge within a subject can be achieved. After some such training it may be better to place the graduate where he has some responsibility and can develop initiative and original approaches to his problems. Earlier abandonment and too early an assumption of responsibility often lead to a wasteful repetition of effort which may culminate in frustration.

I have not said anything about the training of the veterinarian who will undertake responsibility for the laboratory providing a service for the study of specimens from individual cases. These fall into 2 main categories: those requiring biochemical examination and those which demand microscopic assistance. Both aspects would fall, in some measure, within the V.I.O. type of training in any post-graduate course but in certain cases there would be a place for a veterinarian undertaking post-graduate training in the field of biochemistry or cytology. It might even be possible to combine these, but my own view is that basically these 2 subjects are too divergent to be easily combined in one person's speciality. We already have, in the profession, a number of veterinarians who hold biochemical qualifications and are ideally suited to undertake charge of a laboratory providing a biochemical service. Any such service should be controlled by someone who has had a full biochemical training otherwise he will not be in a position to benefit from new discoveries or to solve difficult problems which arise in the laboratory.

I have little to say on the details of such a training, not because it is unimportant, but because it conforms to the usual pattern of post-graduate university education.

to implement a correct diagnosis. It is, therefore, imperative before a veterinary surgeon can provide for his patients the best treatment (and what is often of more importance the best advice on preventive medicine), that his diagnosis is beyond question. No matter how good his clinical perception, this can in many cases only be provided with certainty by means of laboratory methods. He is a fool who would try to negative a possible anthrax except by means of a blood smear, or a tuberculous udder by any but laboratory methods, to mention only two very obvious examples.

The diagnostic laboratory service is an essential and integral part of everyday veterinary practice. There will be some who say the veterinary surgeon should do these things for himself, and that may well be true in limited degree; but if one examines even the simple examples previously given it will soon be evident that should one's initial microscopical examination be doubtful, recourse may have to be made either to cultural or biological methods which are clearly the field of the laboratory worker. There are at present a number of veterinary practices whose members have set up their own small laboratory for the further investigation of their own cases. These can deal with such an examination as that for the diagnosis of parasitic disease either by egg counts or actual worm identification. They can also provide useful service in determining to some extent a bacterial diagnosis, and the sensitivity of the organisms to the various antibiotics. There must, however, be many cases where more advanced cultural techniques are called for which are beyond their scope. In the small practice such laboratory work will almost certainly be relegated to the evening and can very soon become a heavy burden to the practitioner during a busy period, or where staff is short. In the larger practices where a technician is employed there would appear to be a danger of him assuming undue responsibility for diagnosis where, in fact, the ultimate decision must rest with the veterinary surgeon. In these circumstances most veterinary surgeons prefer to send their material to a fully staffed laboratory such as the V.I.O. centre, or to one of the laboratories run by private firms. In this respect usefulness is intimately related to the distance between the practice and the laboratory: it is becoming abundantly clear that a useful bacterial diagnosis is in many cases only possible when the material is examined in a fresh condition. This is particularly the case in ruminants in whom *post-mortem* putrefaction is extremely rapid. It is very desirable that a laboratory should be available within a radius of 30 miles in order that the specimens can be taken there direct by car. The normal alternative of rail travel usually entails a delay of at least 24 hours during which time the bacterial flora of the specimen have undergone a very marked change. In addition, it is of inestimable value both to the practitioner and the laboratory worker for the former to be able to supply an eye-witness account of the animal while alive, and what were the *post-mortem* appearances when the carcase was first opened.

The services which the practitioner require of a laboratory fall roughly into 2 classes. The first and more numerous embrace those routine tests which a veterinary surgeon must have in order to carry on his normal practice and include such things as blood agglutination tests and the testing of all the cows in a herd for the presence of mastitis organisms. The second type of service includes the laboratory examination of specimens from cases in which the initial diagnosis is still in doubt. This may call for bacteriology, histology, or biochemical analysis dependent on the case in question. In such cases, awaiting diagnosis, there may be animals ailing or dying for which the veterinary surgeon can prescribe only symptomatic treatment until his diagnosis is complete. In farm animals severe outbreaks of disease can develop very quickly so that the practitioner who already provides a continuous service to his clients finds that his need for a laboratory service is also continuous. In this respect our Veterinary Investigation Services maintain a very high standard of service, though it would be a big advantage if they were closer together than is the case at present.

It may add conviction to what has been said already if one cites the laboratory aid necessary in the investigation by the practitioner of one or two everyday problems. If, for instance, one is asked to investigate a problem of infertility in a herd of dairy cows there would be an initial visit to the farm to check the herd history and records of service dates. One would probably examine a number or all the cows rectally to check whether they were pregnant or not and to determine if other abnormalities were present. In order to eliminate the question of infection it is probable that one would take a number of blood samples for the agglutination test for *Br. abortus*, and a number of vaginal mucus samples for the agglutination test for *Vibrio fetus*. A semen sample from the bull might also be taken which the veterinary surgeon could examine himself, but which if he wanted examined for infection might well go to a laboratory. It is also possible that blood samples might be sent for biochemical analysis for copper or iodine.

In another case a farmer may be informed by the Medical Officer of Health that his milk has been found to contain *Br. abortus* organisms. In his efforts to detect the offending cow the veterinary surgeon will probably make use of a wide range of laboratory testing, including blood agglutination test, milk ring and whey tests, vaginal mucus tests and possibly cultural milk tests. Many sheep diseases such as lamb dysentery or enzootic abortion call for extensive programmes of vaccination or serum treatment if the losses caused by them are to be controlled. Such treatments can be quite expensive and it is very advisable to be certain of the diagnosis before such expense is incurred.

So far the argument has been solely concerned with farm practice, but there are many occasions in small-animal practice when the services of the laboratory are urgently required. Thus if one is experiencing losses on a mink farm it is imperative that a diagnosis of a disease such as distemper should be made as early as possible, and this can be done only by labora-

tory techniques. The knowledge of the blood urea values of a nephritic dog or the biopsy of a piece of neoplasm may be of great value to the clinician in making a prognosis.

Each year fresh developments occur in laboratory methods which permit the practitioner to improve his methods of diagnosis and treatment. Thus the science of blood groups, which has meant so much to human medicine, is just beginning to receive attention in the veterinary world where ultimately blood grouping may be used in far wider fields than is at present the case. The present trend in the veterinary world is towards specialisation which in turn calls for more precise diagnosis in the field. It is difficult to see how this can be achieved without even more laboratory assistance than is in general use to-day. This does not imply that the level of clinical ability need decline, since by being able to confirm a clinical diagnosis by laboratory methods one is able in the long run to correlate more closely the clinical signs associated with that particular disease.

In any case the rôle of the practitioner does not end with diagnosis, he must institute treatment, nursing and possibly preventive medicine for the remainder of the herd if he is to develop to the full his usefulness to the community.

The Speaker's Introduction

The Chairman, Mr. A. M. Graham, said that there were 4 speakers to deal with the subject of the symposium. The first was Professor D. L. Hughes from Liverpool University. He had been Chairman of a B.V.A. Committee inquiring into the matter. Secondly, there was Mr. R. M. Loosmore of the V.I.O. Service, who would be discussing that side of the subject and the structure and availability of the laboratory services. Then, thirdly, there was Professor W. L. Weipers, Director of the Glasgow Veterinary School, who would be speaking on the training of personnel to man such a service. Professor Weipers was also a member of a committee that was inquiring into laboratory services. Lastly, there was Mr. J. B. White of Salisbury, who would talk about the practising veterinary surgeon's need of laboratory services.

Professor D. L. Hughes referred to the need for laboratory services, and said that investigations of the Association's sub-committee revealed the extent of laboratory work undertaken for practitioners by the Veterinary Investigation Service, and their appreciation and dependence upon it. He believed that the next decade or two would see further striking changes in professional activities. He suggested in the paper that links with Europe might become closer, and if that were true, it would have considerable repercussions on agriculture. Since he wrote those words subsequent events re-emphasised that probability that agriculture would have to face changes. Whatever safeguards were devised for the well-being of agriculture, it would have to improve its competitiveness and continue the great strides in efficiency it had made over the last 20 years. A flourishing and prosperous agriculture was needed and desired, but agriculture must also support what will probably be the national wish to adhere to the European Community more closely. The profession's part in that was obvious, for it must continue its efforts to reduce the inefficiencies of livestock production caused by disease and poor husbandry. To those ends professional competence would be largely a reflection of diagnostic precision. To-day and ever increasingly in the future the diagnostic acumen of the veterinarian in the field would need laboratory support.

The present financial climate was not particularly congenial to those who asked for more, nevertheless if the profession were to think of the future, it was necessary to exert pressure on the Government to extend the provision of laboratory facilities through the Veterinary Investigation Service. The strengthening of the Service was an essential need if agriculture were to be adequately supported against the stresses of the European link. New techniques in husbandry would produce new disease problems and a freer trade in food products might well expose the country's livestock to the risks of infections not as yet present. A failure to provide adequate diagnostic facilities would be inexcusable.

The problems of the small-animal practitioner were different from those dependent on agricultural practice, but if anything they were more urgent for the laboratory facilities available for small-animal material were totally inadequate. In the paper he made the point that, economics being what they were, the solutions must be found within the profession. It might be possible to persuade some of the animal charities to divert their considerable wealth to more worthwhile forms of activity, including the support of laboratories and research. Indirect suggestion and even direct proposals from the Association to that end would be worth considering. Nevertheless, enough laboratory help for small-animal work must in the end be provided by the profession, either in the form of group practice laboratories or much more laboratory activity within each practice.

That led to the next problem which he wished to emphasise, namely, that of manpower. Those who were familiar with the present training of veterinary students and who could compare it with that of 30 years ago, would be aware of the great improvement which had taken place. The present young British veterinary graduate had had a theoretical training which was second to none. If there were a weakness it was that he had not had enough opportunity during training to do the things he was told about. In pathology its extension as an applied subject would be a direct contribution to some aspects of the problems now being discussed. As far as the Liverpool school was concerned, the new buildings would allow that to be done and a start had already been made. The graduate of the future must not be afraid of the laboratory bench, and one could envisage a future when the principal of a practice, in seeking an assistant, would require a modicum of laboratory expertise as a necessary qualification.

Those were thoughts on the basic professional requirements, but they would not provide the specialists and consultants needed in the laboratory centres. For that the schools must give serious consideration to what post-graduate courses they could provide and what kind of courses were needed. As far as pathology in its broadest sense was concerned, he was convinced that the veterinary schools were best equipped to teach both its principles and applications, and one hoped the employing agencies, particularly the Ministry of Agriculture, would increasingly insist on such training for their recruits.

The supply of adequately trained recruits for such work would be governed to a considerable extent by the remuneration offered and in the short term that gave him cause for concern. The distortion between salaries in public and academic service and private practice was sufficient to make selection of the abler young men for laboratory work difficult.

However, in professional matters he was an optimist. The future would be one of challenge and great opportunity. The context in which professional skill and training were used might well change, perhaps in ways some might not like, but they would still be veterinary surgeons.

Mr. R. M. Loosmore paid tribute to Professor Hughes who, he said, had done a great amount of work on the subject. The questionnaires sent out were completely confidential to him for obvious reasons. The Committee knew what was said, but did not know who said it. Therefore, Professor Hughes had to do all the work.

There was no need to emphasise the structure. That had been put down in one place for the record, and it was not necessary to enlarge on it.

The question of the availability of diagnostic laboratories was dominated by two factors as far as he was concerned. One was the terms of reference under which the investigation laboratories worked, and the second was the distance of the laboratory from the practising veterinary surgeon.

The first point was that those in the investigation services were limited to work coming from economic animals. Furthermore, the work was supposed to be connected with outbreaks of disease in economic animals and not to deal with the individual animal. In his view that left a big gap to be filled if the scope of veterinary laboratory work was to expand. The diagnosis in life of diseases of the individual animal was a subject which had not received a great deal of attention from laboratory workers in the profession, but which would be seen in any hospital laboratory in human medicine taken to a very high degree of skill. That field had scarcely been touched at the moment. There was a rôle there for the small-animal laboratories and also for some other organisation in the large-animal field. He did not desire to labour the point which Professor Hughes made that laboratory examination did not constitute diagnosis. The liaison between the practitioner and the person in the laboratory was a most important factor, and it was gratifying to be able to say that it was now very widely understood on both sides, and the provision of complete information to the people in the laboratory would not only help them decide which examination should be carried out, but would also help them to come to an opinion as to what the diagnosis might be. He felt very strongly that the laboratory worker should not be regarded as purely a laboratory man who did tests and reported back. He should have experience and training in the clinical aspects of the work in order that he might put together that which he knew and give his opinion on what was happening.

Coming to the question of distance, it was probably the most important one of all. He had an analysis of the work done by the Veterinary Investigation Centres in 1955, and it showed clearly that a laboratory did not give the service which was required over a distance of about 50 miles: 66 per cent. of the samples of the Reading Centre came from practices within 30 miles; 98 per cent. from practices within 60 miles. Those figures were much the same at other centres, and it showed clearly that a laboratory was needed within 50 miles of every practitioner within the country. While still on the subject of availability, the question of charge arose. He did not feel, in his official capacity, able to discuss that subject, but the Veterinary Investigation Service was in effect part of the agricultural subsidies system. Furthermore, a service of the nature of the Investigation Service fulfilled not only a day-by-day diagnostic function, but was also able to watch and try to assess what was happening in animal disease in a wide area. There were senior officers who watched and who tried to assess what was happening in the whole country as a result of reports from the various centres. Material had to be supplied to research workers, and it was necessary to carry out field trials for research workers as well as supplying information to teachers and others.

Any system of charging or economic charging because laboratory work was highly expensive would be liable to distort that picture, and it might be regrettable to lose something which was extremely valuable.

In his view the distance factor was overriding. The Animal Health Trust units, the university laboratories and commercial house laboratories all supplied to a varying degree a regular day-by-day diagnostic service, but they could not overcome the distance factor. The question then arose whether expansion was necessary. It was not for him to answer that. If it were deemed necessary, then the Committee survey did seem to show that any expansion must come through the Government services of the United Kingdom and Northern Ireland or through the Animal Health Trust or the private laboratories. The universities at the moment were not in a position to provide the day-by-day service which seemed to be required by the veterinary practitioner. He emphasised "day by day."

He felt that what was wanted with the government service was a laboratory within 50 miles of each practice. Secondly, in order to staff the extra laboratories which would be required—probably only 5 would be required to do it—some method of educating workers for that type of laboratory would be required. There were different ideas on the form such a course should take. His own feeling was that it should not be, so to speak, a technicians' course, but should include good instruction in laboratory techniques and the use thereof which, in his opinion, was not taught to any degree in the general veterinary course. There should be further education in the 3 or 4 disciplines used day by day in the diagnostic laboratories and, above all, that education should take place in an atmosphere where deductive thinking was encouraged. Diagnosis had been described as arriving at an unwarrantable conclusion from insufficient evidence. In the investigation type of work there was never sufficient evidence. It was necessary to arrive at some sort of conclusion fairly quickly, often before all results were available.

He had dealt with the nature of specialisation in the paper, and would only reiterate his feeling that the application of moderately deep knowledge of several disciplines to one species was the best way. A circulation round the species would be practicable for a young man over a number of years, to give him not only knowledge of, but the balance between, the species which was so important.

It should be made clear that a laboratory diagnostician was a specialist, and should have readily and speedily available the techniques he required to fulfil his speciality. In a laboratory designed for diagnosis the arrival at a result should have absolute priority, and should not have to compete with other commitments, either teaching or research. Speed was what was essential, speed in applying the test, and delivering the result to the place where it was needed. He had put forward only two alternative ways in which the V.I.S. might develop, both of them designed to place diagnostic techniques in the hands of veterinarians with no other commitments. He had stated the advantages and disadvantages. He would be perfectly happy to carry on as at present, gradually evolving a system. After all, much progress had been made in a short time since integration as a service.

He had dealt at length with government laboratories. They were the biggest factor at the present time and on an economic basis seemed to be likely to remain so. It seemed that no other organisation or combination of organisations could give the necessary national coverage. It would, however, be a very bad thing for the profession if no alternative laboratories were available for consultation.

Speaking of practice laboratories, his own feeling was that that type of laboratory serving one large practice or a number of small practices was bound to come, and was a very good thing if only for the reason that it was much quicker to do a thing oneself than to send it away to someone else. They could take a great deal of routine work out of the bigger laboratories, and the facilities of those laboratories could then be put to better purpose.

Professor W. L. Weipers said that all speakers were unanimous that diagnosis must be supported by laboratory methods. There also seemed to be fairly general agreement that there was an acute shortage of laboratory assistance. Some of the speakers had indicated that they did not like the idea of the designation laboratory diagnostic service because it implied that diagnosis could, in fact, be achieved in the laboratory. If, however, one took the extreme case, diagnosis could be made in a laboratory, but an ideal medium was where one obtained close collaboration between laboratory workers and the practitioner in the field. Many people were using the Veterinary Investigation Service as a kind of direct successor of the High Priest of Delphi who studied the entrails of animals and attempted to reach a diagnosis on that evidence alone. Human nature being what it was, practitioners were always

anxious to pass on the awkward piece of practice to someone else and they passed it to the V.I. laboratory. This was not the purpose of a laboratory service.

There had been some confusion in the papers concerning that which was being discussed. The title of the symposium was "Provision of a Laboratory Diagnostic Service," whereas many speakers were discussing the V.I. service which was only one aspect of the subject. It should be made clear that the V.I. service had two main purposes: one was to supply the laboratory service in the same way as an outside laboratory would; and the other was to supply a consultant service. It might also be said that the service was a repository for the awkward cases which the practitioner did not want.

It was necessary to look at the broad picture of diagnosis, however, and to see what facilities could be used by the veterinary surgeon to supplement his clinical examination of cases. Professor Weipers then referred to a table in which he had attempted to show all the means whereby additional help could be got by practitioners in difficult cases. This referred to the different species of animals and distinguished between individual animals and herds of animals. The veterinary surgeon in practice could expect to receive help with infectious disease in groups of animals from the field staff of the Ministry in relation to the Scheduled Diseases, and from the V.I. service in relation to other infectious diseases. He could also expect assistance from the Veterinary Investigation Service for groups of animals suffering from diseases that might not be infectious but might arise from metabolic, toxicological or other causes. Help in groups of animals might also be had from consultants in private practice or from the consultants in the schools, but in all these cases the amount of assistance that could be given would depend often on the availability of laboratory services and the advice of specialists in different disciplines. Because of this the consultants in the schools were being increasingly used.

In the field of individual farm animals there was a great hiatus in consultation service combined with laboratory facilities. The profession was not utilising sufficiently laboratory services in this field in selected cases. In obscure difficult cases few comprehensive facilities for diagnosis were available and probably only those who had worked in clinical departments in the schools had been able to use, to the full, this approach. Laboratory service was an expensive commodity. It might cost more to carry out a biochemical examination than to make a clinical examination of an animal. When a consultation was required in small-animal practice it might be obtained from another practitioner who was a member of the practice; alternatively, advice might be sought from an outside practitioner who had specialised in a particular field. Consultants were also available in the veterinary schools and in some research centres like the Animal Health Trust. As horses had ceased to be important in the over-all economy of the farm they tended to be more or less in the same position as the small animal as far as the provision of consultation and laboratory service was concerned, and arrangements tended to be similar to those applying in small-animal practice.

Having looked at what was available, it was clear that there were large gaps in the consultation and laboratory services and, unless there was a major departure in policy, the V.I. centres could not cope with the present position.

As far as training was concerned, training must be post-graduate. Undergraduate training could only be of a very wide general nature and must avoid specialisation. There were two main kinds of post-graduate training for those people who would be connected with the comprehensive laboratory services. The first was the training in a discipline where the person would study in a university for 3 years at post-graduate level and take a Ph.D. He would later work in a laboratory of his own discipline and it would be a year or two before he began to work on his own, probably in association with workers in other disciplines. Such people could give great assistance in the laboratory service.

The second method of post-graduate training concerned a man who worked in the V.I. laboratory or a similar diagnostic laboratory. Professor Weipers agreed that he was a specialist but he had to be a general specialist. He would be a specialist who had studied those aspects of pathology, bacteriology and parasitology, which would be important in reaching a diagnosis. Professor Weipers said that his own view was that the V.I. Service's primary purpose was to improve diagnosis. That was the whole reason for the existence of the service. Therefore, if a post-graduate course could be offered that would place emphasis on all those aspects, there would be very great advantage in it being done as a year's post-graduate training in a veterinary school where there were departments of animal husbandry, and where teaching would take place against a clinical background.

The V.I. Service would work in close collaboration with practitioners in the field, and if training could be evolved against that background, it would be an ideal way of doing it. If such courses could be carried out at some of the veterinary schools it would be useful. The schools seemed to have let the profession down by not taking on routine laboratory diagnostic work and it would now appear that there might be some difficulty meantime in mounting a post-graduate course of the kind proposed. The staffs of the veterinary schools were overtaxed with their ordinary teaching commitments and also those for training the post-graduate degree students and it would be difficult to set up yet another course which would take up laboratory space and staff. He felt sure that the type of course proposed could be set up and there was little doubt that in time something of the kind would take place.

There was a great difference in the training of these two types of people and the question would arise after a period as to whether there would be difficulty in translating staff from one sphere to another.

Mr. J. B. White said that the short answer to the title of his paper—"The Veterinary Surgeon in Practice and His Need for Laboratory Services"—was that by employing laboratory services the veterinary surgeon could in many cases obtain a more accurate diagnosis in less time than was hitherto possible.

The cry for more and more speed had become something of a fetish to-day, but one quickly learned in practice that that was as true on the farm as it was in the factory. The longer it took an animal to recover from an illness, the greater was the cost of food for maintenance and man hours to look after it. One of the things which one was made to realise in farm practice to-day was that farming was no longer a placid way of earning one's living, but was becoming a keen tough business just as much as the many other types of heavy industry. Commercial farms, not sporting estates, were changing hands in Wiltshire for sums up to £100,000. Farmers to-day had their farms costed in detail and in many cases were very keen and astute businessmen who expected a treatment based on a scientific diagnosis and sound therapeutic principles, and it was essential that full use was made of the modern methods which were available.

The farmer was, moreover, employing regularly the services of laboratories associated with N.A.A.S. or commercial firms from whom he received reports and analyses of soil, silage and other food material as well as of plant diseases. It was essential that practitioners showed themselves ready to make use of modern diagnostic methods to the full in order to give the farmer's livestock the best treatment, and to give him the best advice on preventive measures.

Mr. White said he did not wish to give the impression that he was content to rest on a laboratory report alone, and that the part of the clinician was becoming unimportant. A laboratory report could only be given the best interpretation by the practitioner in the field who then knew the full story, and could give the best advice to suit each individual case. Modern drugs were generally expensive and to use them to the best advantage they must be employed to support a sound diagnosis, and if possible they must be used early in the disease before there had

been too much tissue damage entailing loss of functions and a lengthy period of repair.

Equally important and equally dependent on a sound diagnosis was the advice and help to be given in preventive medicine including such matters as grazing management, supplementary feeding, housing and ventilation. It was becoming increasingly necessary for a veterinary surgeon to be thoroughly acquainted with the systems of husbandry practised in his area.

That was a field in which there was tremendous scope for work by the clinician when he could give sound valuable advice to the farmer, and who would gradually come to realise that such advice was worthy of a professional fee. It was difficult to decide just how much the veterinary surgeon should do for himself as regards laboratory work. There were some of the more simple procedures which he could very well undertake for himself, such as faecal worm counts. It was particularly useful to be able to determine the drug sensitivity of an infective agent at the earliest possible moment.

Against that many procedures were clearly beyond the resources of the small laboratory, and it was better to recognise that and send such tests to the more specialised laboratory. In addition, such services were expensive and he doubted the ability of the laboratory run by the practitioner fully to recoup the heavy overhead expenses which were involved, particularly when running on a small scale. In his own practice laboratory facilities were used fairly extensively though not as fully as in some practices.

During the first 6 months of 1960 approximately 400 samples were sent away, and they comprised the normal routine services necessary for practice: they were 141 faecal egg counts; 70 biochemical blood samples; 40 *Brucella abortus* agglutination tests; 4 tests for *Salmonella;* 4 enzootic abortion; 10 *Vibrio fetus*; 50 Johne's disease; 3 ringworm; 3 analysis for lead, and 45 mastitis samples, plus herd samples. Those tests were, in the main, ones in which the material would travel by post and train without serious loss of value.

When, however, it came to specimens of *post-mortem* material sent for a diagnostic examination, it was essential that they were examined whilst still in a fresh condition, particularly when they were from ruminants. It was then that there was a very great advantage if the laboratory were not more than 30 miles away so that the veterinary surgeon could take the material in a fresh condition and could give a personal account to the V.I.O. Practitioners were notoriously bad as writers of case histories, but were usually willing to discuss the case at length with the V.I.O.

He had not mentioned the great benefit which the practitioner could gain in consolidating his ability as regards his diagnostic skill by making use of laboratory services. Many conditions arose which he recognised as a distinct clinical entity, but which he did not recognise as a named condition. By making full use of the laboratory services and of the V.I.O. services, he was often able so to consolidate his clinical impression that in future he could arrive at a sound diagnosis by clinical observation alone.

He had not done justice to the small-animal practitioner who required the services of a laboratory in just the same way as did the country veterinary surgeon. There were many cases in which an early examination of blood or urine could be of inestimable value to the clinician in arriving at a sound diagnosis and prognosis with his small-animal patients.

The General Discussion

Mr. A. J. Stevens (Cambridge) said there were 3 points which, in his view, had been somewhat over-emphasised, and which he desired to challenge.

The first concerned the hiatus for laboratory diagnosis for individual animals mentioned by Professor Weipers. He contended firstly that it did not exist, and secondly that if it did it should! Few cases were clearly black or white. For example, was the individual Johnes case which occurred only every 3 or 4 years on a farm an individual case or a group case? Similarly with milk fever; did it count as a herd or an individual case when only one cow was affected? Admittedly there were individual cases; for example where haematology was needed and where at present a service was not fully provided, but economics were, and should be, a strict limiting factor. He did not think that the veterinary profession should try to emulate the medical profession in this way. It might be that human cases were worth any expense—some very much doubted it—but the veterinary profession was not financed as a National Health Service and some did not think it desirable that it ever should be.

Secondly, with regard to further training, he wondered whether the university was really the right place for a diagnostic laboratory worker. In his own view it was not. Veterinarians had all received university training and what they needed now was practical mixed training, emphasising the technique of investigation, including perhaps some Sherlock Holmes work at the Police College! Therefore, he suggested that the training which was necessary would have to come from within the Government establishments.

The third point concerned distance. Some people thought that many more laboratories should be provided to increase their accessibility. In theory, and to a certain extent, this would be good, but should not be carried too far. It was sometimes a good thing to have a deterrent to unnecessary specimens and again economics come into it. It was always difficult, and particularly so for a busy practitioner, to write down lengthy histories, but writing, he believed, was part of seeing and observing and sometimes it was only when one came to record the history that one realised that one did not know whether the animal was a Friesian or a Jersey! Having to write a history often led to better observation and there should be no undue haste to move the deterrent too far.

Professor Weipers, in reply, referred to the provision of laboratory services for the individual animal and said it was certainly not the original concept of the V.I.O. Service. This service was part of the Advisory Service of the Ministry of Agriculture and it was presumed to relate to herds and flocks. Mr. Loosmore had made the point that that did not necessarily apply and there were many cases where advice was sought in relation to individual animals. Mr. Stevens said that they were consulted on individual milk fever cases but milk fever might be a reflection of the management and constitute a herd problem. There was a large hiatus in the consultation facilities available for the individual animal: one should not be tempted to ape what was done in human medicine and apply every aspect of laboratory procedure to the individual animal, but there was still a case for laboratory help with individual animals. He had in mind the difficulty encountered in individual cases where, on clinical grounds alone, one could not arrive at a diagnosis and one wanted day-to-day laboratory examinations. If a decision were taken that that was not wanted in any circumstances by the profession then it would be a case of opting for mediocrity.

As to the second point, he had suggested that a post-graduate course would be appropriate for those taking up V.I. work. It might not be possible but it would be an advantage. If Mr. Stevens were suggesting that alternatively one should follow more or less the apprentice system and, on appointment, put the young V.I.O. into the laboratory, there would inevitably be great unevenness in the kind of training he received. If, on the other hand, he had in mind mounting a formal training course outside the universities, it might well be successful. In Professor Weipers' view, post-graduate training was essential for every branch of the veterinary profession nowadays. He did not know whether the university schools could supply the type of course on diagnosis which he envisaged for V.I. workers and others, but in his view such a course was necessary.

Professor D. L. Hughes, in reply to the second point, said that the present situation was that there was no provision at all. He knew that the Ministry would challenge that as far as the Veterinary Investigation Service was concerned, but, frankly, he was unrepentant. He gathered that the present system was that the young man was taken into the service, he was then sent to Weybridge for some time, and

he went round the different departments of Weybridge acquiring knowledge and expertise from the experts. But that was not really a system because it was an added burden on the department which was already very busy, and the amount of information and training that the man received in those departments varied very considerably. It was a direct reflection of the time, enthusiasm and the general liking for teaching other people that the individuals in those departments had. The result was that the man came out unevenly trained in different subjects, and it varied a good deal from one year to another how much he received. In Professor Hughes's view it was inadequate training for men who were going out into the Centres. However, he did not suggest that a university course, however formal, would provide veterinary investigation officers who were fully experienced and ready to do work in the field, for they would have to learn to apply their formal training in the Centres.

Mr. R. M. Loosmore, in reply, said that Mr. Stevens was confusing education and vocational training. The type of person who was required in the future should have done, almost to an ordinary degree standard, the academic specialities which he required in his work. Vocational training could come after that.

On the question of the hiatus, he agreed with Mr. Stevens that it applied mainly to the small-animal field, but at the moment it would seem that insufficient attention was paid to diagnosis in the individual animal.

Mr. J. B. White, in reply, referred to the question of writing as opposed to sending a specimen, if the letter enabled the V.I.O. to make an immediate diagnosis, then it was adequate. But no doubt there were few cases where the V.I.O. would not like to ask further questions which was difficult to do with a letter.

The other point was whether there was a tendency to use laboratory services unnecessarily. If that position came about, he suggested it could be checked by a token fee.

Professor C. S. Grunsell (Bristol) congratulated the 4 speakers on the able way in which they had introduced the subject, and on the clever way in which they had been complementary to each other in their contributions.

At Bristol those concerned fell into Professor Hughes's category of "schools trying to restrict laboratory diagnostic service" or, one might put it, being forced to try to restrict commitments in that direction. Those in his department who had been in practice felt very sorry to have to do that, because, perhaps, they knew how painful it was to suffer from diagnostic destitution. No one would deny that there was a very pressing and urgent need for the expansion of facilities, particularly in connexion with cases involving the individual valuable farm animal and the dog and cat. But it went further, of course. It was very gratifying and encouraging to see Professor Weipers draw attention to the need to superimpose on and perhaps gradually replace the *ad hoc* fee basis between farm and practitioner by some financial arrangement giving easier access to herd and flock problems in both production and disease prevention. But as Professor Weipers so rightly pointed out, the lack of fully comprehensive and readily available facilities would certainly seriously hamper that evolutionary trend. Professor Grunsell strongly supported a really bold development of the V.I.O. Service on the lines suggested by 2 of the speakers as providing probably the major answer to the problem. Like Professor Hughes, he saw no reason for not asking the farmer to pay for the service.

But what of the university schools' responsibilities in that matter? It might be that ultimately schools would be doing little more than providing the training of personnel going into diagnostic laboratories, although even then some means of providing a steady flow of a representative sample of material for undergraduate and post-graduate teaching would be required. But what of the school's responsibilities in the immediate situation which was likely to persist for 5 and may be 10 more years? In his view they could legitimately be expected to help, and many felt that it was their duty to do so; but because of the priority which must be given to teaching to be fair to the students, and research to be fair to the staff, it was not possible to extend commitments. No clinical department responsible for running a practice attached to a school would think of trying to manage without one member of the staff specially appointed for the purpose. Was there not an equally valid case to be made out for the appointment of a clinical pathologist with no formal teaching duties to organise the laboratory diagnostic service for the school? He would of course be backed by adequate technical staff and would be able to call on the specialist knowledge of his various colleagues when required. In other words, the set-up already existed in the schools. That could, of course, also be an advantage to the schools provided really good histories were sent in and there was "follow up" information. He emphasised that what he had suggested was only an interim measure, and he could not answer the problem on a long term basis for many reasons, of which the geographical distribution of the schools was a very important one.

The practitioners must be prepared to help themselves. He was convinced that laboratories attached to practices could make a very real contribution to the problem. Practitioners generally overestimated the difficulties of establishing facilities to handle simple laboratory diagnosis. The financial implication of setting up small laboratories in practice premises was obviously no problem and would not compare with the capital outlay involved in, say, the installation of radio-telephones.

Mr. E. M. Pittaway (Coventry) said that reference had been made to the training of research workers, and reference had been made to what laboratory facilities should be provided in the future, but no reference had been made to how those who were in practice would be trained to use those facilities.

Many practices could provide facilities for doing laboratory work economically without any great difficulty, particularly in small-animal work. He had done it for 5 years and knew that an economic service could be provided for 85 per cent. of the laboratory needs by having technicians and providing the capital for equipping a small and versatile laboratory.

It would seem that the general view was that the Veterinary Investigation Service should go on as it was at present, and there should be a race of super practitioners with the backing of laboratory facilities. That was certainly a great need, but in his view it was not what was wanted in the future. It was specialists in certain diseases who were wanted in the future. How they would be provided under the present system was difficult to say, but that was surely the ultimate objective. In the small-animal world there was already a move for specialists in particular diseases. The small-animal practitioners were crying out for it and no doubt a similar situation obtained in large animal practice.

Professor Hughes, in reply, said that Mr. Pittaway happened to be one of the pioneers in the field under discussion. He felt the need and did something about it. He had equipped a very nice laboratory for that purpose, and it would be a practical contribution if he were to state what the capital outlay was. Mr. Pittaway had been to various laboratories to pick up particular techniques, and he came back and used them. It was a real example of "do it yourself." There were few individuals who had done likewise.

For example, it was ridiculous to have a sample of urine sent through the post to a destination a hundred miles away for examination of albumen, casts, debris, and so on; but it happened. It was criticism of those who did it, but it was equally criticism of the people who trained them.

One of the short-term answers to the problem was for the schools to turn out men who were prepared to examine samples by some of the simpler straightforward tests for a number of things.

Mr. Loosmore (in reply) said that the concept of the practice laboratory was one which had not been developed to anything like its potential.

On the question of the V.I.O. service remaining as it was, he could not agree more. He was well aware of his own

shortcomings. Mr. Pittaway suggested that there should be specialists in a disease or a group of diseases. The middle stratum, so to speak, should, in his view, concentrate on a species basis. The width within which the veterinary surgeon had to work was very great. The general practitioner had to have a wide knowledge, and short of specialisation within a practice it was difficult to see any way round that. At the other extreme there were workers in research institutes and universities who specialise in one disease or one group of diseases or one discipline. The Investigation Service provided a middle stratum and provided moderate depth, but the size of the service and staffing militated against specialising too deeply in one subject. The young worker in the Investigation Service would go on to become head of the V.I. Centre, and if he had specialised too closely, he would not have the essential balance.

Mr. Loosmore said he would prefer, therefore, to have species specialisation at moderate depth, and if possible to circulate the young people through the various species. In that way they could acquire knowledge not only of the diseases, but of the economics and husbandry, and so on, in connexion with different species, these being inseparable from the problems of animal health.

Dr. R. F. W. Goodwin (Cambridge) said he was interested in Mr. Pittaway's remarks, because he had voiced a need for another type of organisation which the practitioner wanted. Dr. Goodwin had given his views on the development of such a consultant organisation for practitioners elsewhere, and he would not enlarge further on it, therefore, at that moment.

Related to that matter, however, was something that Mr. Loosmore had included in his paper. He had stated that it seemed unlikely that the universities would play any major part in the institution of laboratory services, but that they would play an increasing part in the consultant side of the profession. He had not said any more, because the symposium was confined to laboratory services, but within that statement there was the idea that Mr. Loosmore saw those things as 2 different entities—consultation services and laboratory services. It would be of interest if he could elaborate a little on that concept, and state how he saw the difference between those 2 services, both of which the practitioner required,

Mr. Loosmore, in reply, said he was working within the terms of the title of the symposium which referred to laboratory diagnostic services. Nobody liked the phrase, but he had tried to bring out what he meant when he emphasised that it was day by day.

The provision of an overall service which was available when people wanted it did, in his view, depend on the laboratories being available in distance and all other respects. He did not feel that in present circumstances the universities were likely to provide that day by day diagnostic service which was required. He referred to his conception of a three-tiered system, and in his view the type of investigation worker who was on the ground and easily available was the one who was going to be consulted first. But in the very nature of things specialists with a deeper knowledge of certain diseases, group diseases or disciplines were required. At the moment there was reliance on the Central Veterinary Laboratory at Weybridge for those deeper specialists.

The universities had not displayed great interest in providing consultant services up till now to any great degree. He felt not only that they should but that they would. It was essential, particularly for clinical teachers, that they should get out into the field. Therefore, he regarded them as members of the third stratum. They might have laboratory facilities behind them or they might not, but those laboratory facilities might be occupied with other duties, and it was difficult to see why the laboratory facilities of the Investigation Service should not be open to any consultant or specialist from any other institute if he so desired, and if the farmer was going to benefit.

He did not think that the universities in present circumstances were either prepared or able to provide the day by day routine diagnostic services.

Professor W. I. M. McIntyre (Glasgow) said that Professor Hughes and his Committee had stimulated the profession to think again about post-graduate training standards. He said that if the V.I.O. service and the veterinary schools were going to offer a consultant service to the veterinary profession, they must ensure that the personnel involved undertook to study for a Ph.D. qualification following the primary undergraduate degree. At the moment there were not the facilities within the veterinary schools to cope with this task. He would therefore ask the British Veterinary Association to lend all support to the demand that the Universities should begin to meet the requirements of post-graduate training more adequately than at present. Furthermore, the profession should come to expect a more careful and hard-won training from those who set themselves up as people possessing some special qualification.

Mr. L. E. Hughes (Cambridge) said it would appear that there were 2 sides to the subject. One was the training of people or education, and the other was the development of the service. Unfortunately he could not say much about the V.I. service because a committee was investigating its future. At the same time, the economic climate was bad at the moment which was unfortunate; but it might well improve, and some of the things which it was hoped would happen would happen.

It was known that the service was inadequate. Those in the service felt that they were doing a reasonably good job, but it was nowhere as good as they would like it to be. It must develop on a regional basis and there must be a great degree of specialisation for those who wanted to specialise. In other words, a regional development of the service was desirable, and it would probably come.

The question of education was really difficult, because what were those concerned training for? It had been admitted that the V.I.O. was somewhere in the middle. He was not in the top stratum and not in the research workers. It was said that there must be 3 years in which to train a V.I.O.. If there were to be 3 years in addition to practical training, how was the research worker to be trained? If he spent his life being trained, he would not be able to utilise the ideas that he had and do research. If young people could not work at the bench as young people, and were still receiving a formal education at 22 and 23 years of age, many of the original ideas of those young people would be missed. It would be undesirable to superimpose another 3 years on the 5 or 6 years required to train a veterinary surgeon. Therefore, it was necessary to compromise, and in that event it was necessary to give the matter a great deal of thought.

The history of veterinary post-graduate diplomas was poor. A number of such diplomas were no longer in existence, including the Diploma in Veterinary State Medicine of Manchester University which, in the opinion of the speaker, was very good. He hoped that the consideration of this matter would not stop at this point, but that the Committee would go on and add to its numbers those who could help in the development and design of a course suitable for research workers in veterinary medicine.

Dr. K. C. Sellers (Stock) agreed that young people going into research should have 2 or 3 years' formal training but the profession should take its head out of the clouds and ask "where is the money coming from?" Organisations such as The Animal Health Trust gave post-graduate scholarships generally amounting to something in the region of £500 per annum; this meant that a young man of 23 or 24 years of age, after long training courses, had to spend 2 or 3 years with a relatively small amount of money, possibly living from hand to mouth and possibly finding difficulty in devoting all the time he should to carrying out research work. Establishing more laboratories also raised the same question for laboratories were by no means cheap places to run.

In that respect he sounded a word of warning about laboratories which were being set up by veterinary surgeons in practice. They might cost a great deal of money and it would be quite wrong for a clinician to spend time in preparation work, such as washing and sterilising glassware. Another word of warning in the same context; in diagnostic work, new techniques were constantly being developed, and unless a practitioner had facilities allowing

him to keep in contact with persons familiar with recent developments, he might make many mistakes.

However, he supported the institution of some type of post-graduate course for a new species of veterinary surgeon, "the veterinary middle-man." These were not research workers in the classical sense and neither were they clinicians but were people who were interested in field investigations and trials and diagnostic methods. Perhaps the veterinary schools could recognise "the veterinary middle-man" and make facilities for his fuller training.

Dr. W. R. Wooldridge (The Animal Health Trust) said that in 1942 he had the privilege of giving the Presidential Address in which he advocated a nationally co-ordinated laboratory service, and he was very gratified that it had not taken the profession more than 20 years to become enthusiastic about it! When he put the idea forward he emphasised the necessity of keeping it linked with clinical services, and said there should be many hospitals throughout the country. He again emphasised, not because he had changed his basic views, but because the profession was now enthusiastic, that there were a great many pitfails associated with the establishment of a laboratory service. It was because of all those pitfalls that he supported Professor McIntyre and other speakers who emphasised the necessity to keep that service linked with the universities.

One of the reasons for securing university training of the veterinary profession was to give it freedom to develop in a variety of ways at the same time. It was only by developing in a variety of ways that the best solution could often be obtained. At this meeting several solutions had been proposed and they should be allowed to develop, not necessarily in a standardised system. They could be loosely co-ordinated, provided certain basic features were incorporated in each. One feature was the necessity of getting specimens without delay. If laboratory diagnosis was to be of value fresh specimens were essential for no living material remained the same. It continued to change so long as it was fresh, or the tissues were alive, but subsequently it normally changed more rapidly by putrefactive processes.

Even the discovery of pathogenic organisms in a specimen did not necessarily indicate that the animal was suffering from disease; it might have been a "carrier". Those facts must be related to the condition of the animal in life.

One must avoid being dogmatic. The facts had to be interpreted by clinicians, bearing in mind the physiological condition of the animal. It was further necessary in interpreting a laboratory report to have an understanding of the norm of the animals. All too often in the past one analysis of blood or of tissue had been made, and a view had been expressed dogmatically that the result was at normal when in fact those concerned rarely knew what the true norm was, or rarely took into account variations in the true norm.

When the Trust started its haematological investigations it was realised quickly that very little, if anything, was known about the range of normal values and therefore much preliminary work was necessary on a large number of animals to secure that knowledge. Hence a laboratory service could be linked with a research service with advantage. It was fortunate that the V.I.O. Service of the Ministry was so linked.

So far as the financial position was concerned, the laboratory service was very expensive. This was partly due to the necessity of having qualified specialists available to the service. To suggest that someone could go off and do a week's work in a laboratory and then go out and carry out reliable diagnostical techniques was ridiculous. Post-graduate training was necessary.

He agreed that more people were required who were willing to devote another 3 years after graduation to taking a higher degree in the university. This would enable them to stand on their own feet scientifically. It was also necessary to give highly trained people a future, and hence the scientific specialist should be certain of getting to near the top of the salary scales. A pyramid salary structure did not facilitate this.

Mr. A. C. Dixon (Berkhamsted) said there had been much talk of providing consultants as a part of the diagnostic service. A veterinary surgeon in practice, when he accepted a case, accepted responsibility for that case from beginning to end. Should he need help from a laboratory, he could not pass that responsibility on to the laboratory worker. In the case of a consultant he could pass on that responsibility but for that reason the consultant must be a man trained in clinical medicine rather than in the laboratory.

It had been pointed out that to give laboratory assistance in the individual animal might be very expensive. In that respect the practitioner required help of 2 kinds. In one he had made his diagnosis from the clinical picture but required confirmation. He must have that before he embarked on what might be very expensive and specific treatment. In the other case he had no evidence at all from which to build a clinical picture. What he now wanted from the laboratory were a few symptoms. Detailed examination of body fluids, biopsies and the like, might at least tell him the sort of disease he had encountered. That was the type of examination which was really expensive, and might not be worth while for just one animal. In his view that type of information would be of immense value in the long term as practitioners would soon learn to recognise new syndromes which could then be diagnosed on clinical grounds.

Mr. P. J. Dalton (Salisbury) asked why the practitioner should not develop his own laboratory to cope with individual milk samples, faeces samples and routine urine examination. It *should* be done in practice, but it was easier to wrap up a milk sample and send it off.

Dr. S. J. Edwards (Compton) wished to make a suggestion only to the Committee which had been established by Council to investigate the question of improvement in laboratory services. In his opinion, there was perhaps much to be gained by providing part of the service in the form of mobile laboratories which could carry out certain forms of diagnosis on the farm. Diagnosis on the spot had been emphasised by Professor Weipers as particularly valuable in the case of the human patient, but for obvious reasons this was not available in the veterinary field, except in a few animals transported to the clinical centres. In laboratory diagnosis it was sometimes frustrating to find that specimens were unsuitable because of *post-mortem* decomposition or bacterial contamination as in the case of milk or blood samples. This could be to some extent obviated in this country where road distances from a convenient centre to the farm are short but where the postal service could not operate under at least 24 hours, thus making impossible the examination of specimens in the fresh state.

Professor Weipers said that at one time the controlling body, the Royal College of Veterinary Surgeons, did not believe in specialisation. Specialisation was now accepted, and it was a case of preaching to the converted when it was stated that it should take place. It was taking place at present, and there were a number of means for improving diagnosis utilising specialist services. The clinical specialist probably relied very largely in many cases on the laboratory service. In fact, the extent to which he made a full contribution would depend on access to laboratory facilities.

On the matter of training, he accepted that the ideal post-graduate qualification in a particular discipline was the conventional post-graduate Ph.D.; but there was a case for the general specialist on a fairly broad basis, who would have a certain knowledge of aspects of diagnosis in a whole variety of disciplines, and would have had an opportunity to have some formal post-graduate training including training in animal husbandry and of applying it in preventive medicine. Professor Weipers pleaded, therefore, for the general development of the present trend to extend specialisation. The "middle stratum" referred to by Mr. Loosmore was in fact a very useful one but there should not be an assumption that the V.I.O. service was necessarily the last court of appeal in difficult cases and there should be a great deal of consultation beyond that stage.

A vote of thanks to the speakers, proposed by the Chairman, was carried by acclamation and the session then terminated.

Variations in Susceptibility to Infection with *Mycobacterium johnei*

BY

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SUMMARY.—The susceptibility of animals to Johne's disease is discussed, with reference to the species, breed and age of animal, and the dose, strain and route of administration of the organism. Recent experiments on the susceptibility of mice to M. johnei *infection are reported.*

INFECTION, and the progress of infection to clinical disease, is governed by susceptibility of the host and virulence of the infecting agent. In diseases where the infecting agent is relatively avirulent the susceptibility of the animal plays a very important part in deciding whether the disease will develop. There is ample evidence that *Mycobacterium johnei* is not a highly pathogenic or aggressive organism; a high proportion of apparently normal cattle in Britain harbour the bacillus (Taylor, 1949; Rankin, 1954; Smith, 1954), far more than would ever develop the clinical disease. In Johne's disease variations in susceptibility may be important to the disease picture as a whole; the variations in incidence of the disease in different areas, different farms, and in different individual animals may be related, at least in part, to the susceptibility of the stock concerned.

Susceptibility is influenced by a great number of factors; these factors can be partly divided into those concerned with the suitability of the host as an environment for the organism, and those concerned with the defences of the host against the organism.

In the course of a search for a suitable laboratory animal for Johne's disease, it was noted that factors which appear to govern susceptibility in domestic animals have their parallels in the case of laboratory animals, and particular mention will be made of the use of laboratory animals in this respect.

The species and breed of animal, the age at which it is exposed, the strain of organism used, the dose and its route of administration, all these appear to be capable of influencing susceptibility.

Species Susceptibility

Cattle, sheep and goats are the susceptible domestic animals of economic importance in the Western world. Camels (Poddoubski, 1957) and deer (Bourgeois, 1940) can also be affected, and a case is recorded in a llama (Appleby & Head, 1954) kept in a zoological collection. Species naturally susceptible to clinical Johne's disease, therefore, appear confined to the group of ruminants. This is in marked contrast to tuberculosis where the susceptible species are not so confined and this may be a further indication of the general low level of pathogenicity of *M. johnei*. It is not known why the ruminants constitute the natural hosts; Hirch (1956a) has examined the bacterial flora of ruminant intestine with this in mind but was not able to solve the problem.

In laboratory animals experimental infections of the intestine equivalent to Johne's disease have been obtained in mice (Francis, 1943; Lominski, Cameron & Roberts, 1956; Chandler, 1961a), voles (Levi, 1950) rabbits (Rankin, 1958a) and hamsters (Hirch, 1956b). Rats have been shown to be refractory (Chandler, 1961b). Little significance can be placed on the fact that the successful laboratory animals were all rodents, since these constitute the majority of laboratory species. There are no reports of recovery of *M. johnei* from rodents in the wild state.

Breed Susceptibility

It has for long been believed by some members of the agricultural world that cattle of the Channel Island breeds are more susceptible than other breeds to Johne's disease. In a recent survey (Withers, 1959) clinical Johne's disease was found to be more common in the Channel Island breeds. A figure of 2 per cent. was given for the breed incidence of clinical disease in the Channel Island breeds, against 0.4 per cent. for the incidence of all breeds considered together. It was concluded from the survey that there was a highly significant difference between the incidence in Jerseys and that in other breeds.

It has recently been shown that there is a variation in the susceptibility of different breeds of laboratory mice to *M. johnei* infection (Chandler, 1961c). Three breeds of mice were used, namely black C.57 mice, brindle CBA mice and white mice of the Swiss variety. Equal numbers were inoculated with the same dose of *M. johnei* and maintained under identical conditions; samples of mice were killed and examined at intervals. The results are shown in Table I. It will be seen that at 3 months there was some indication of greater susceptibility of the black mice; at 6 months all the black breed showed larger spleens, with higher counts of bacilli and all showed intestinal infection, while the brindle breed appeared least susceptible. At 9 months the results were similar and the *post-mortem* picture in the black breed showed thickened intestines and emaciated appearance. At 1 year and at 1 year 3 months after infection the same general picture of variation in breed susceptibility was obtained. Subsequent experiments have confirmed that the black breed are the most susceptible, the brindle breed least suscep-

* Paper presented to the Annual Congress of the British Veterinary Association in Oxford on Wednesday, September 6th, 1961.

TABLE I
VARIATIONS IN SUSCEPTIBILITY OF DIFFERENT BREEDS OF MICE

Breed	3 months sample				6 months sample				9 months sample			
	Post mortem	Spleen and liver counts	Intestines +ve	Intestines −ve	*Post mortem*	Spleen and liver counts	Intestines +ve	Intestines −ve	*Post mortem*	Spleen and liver counts	Intestines +ve	Intestines −ve
Black C.57	Spleens enlarged	Majority positive	2	13	Spleens enlarged	Highest	6	0	Spleens enlarged Intestines thickened Lack of fat	Highest	6	0
Brindle CBA	Normal appearance	Majority positive	0	15	Normal appearance	Lowest	0	6	Normal appearance	Lowest	0	6
White Swiss	Spleens intermediate	Majority positive	1	14	Spleens intermediate	Moderate	3	3	Spleens intermediate	Moderate	1	5

Breed	1 year sample				1 year 3 months sample			
	Post mortem	Spleen and liver counts	Intestines +ve	Intestines −ve	*Post mortem*	Spleen and liver counts	Intestines +ve	Intestines −ve
Black C.57 ...	Spleens enlarged Intestines thickened Lack of fat Mesenteric nodes enlarged	Highest	6	0	Majority similar to 1 year result	Highest	11	0
Brindle CBA ...	Normal appearance	Lowest	1	5	Normal appearance	Lowest	0	15
White Swiss ...	One mouse only similar to blacks	Moderate	1	5	One mouse only similar to blacks	Moderate	1	4

tible and the white breed intermediate.

It is of interest that, taking all the breeds into consideration the majority of mice showed liver and spleen infection, whereas far fewer (except in the black mice) showed intestinal infection. This may have a parallel in cattle where lymph node infection is far more commonly met with than intestinal disease.

Age Susceptibility

Johne's disease in cattle is produced most frequently when experimental infection is made at an early age. (Taylor, 1953; Rankin, 1958b.) Up to about 6 months of age and possibly longer, calves are susceptible to infection; adult cattle, however, are far less susceptible. It has been suggested that the reason why adult cattle are comparatively resistant is that they have obtained some immunity in early life; but Rankin's experiments (1961) do not support this view, at least in so far as specific immunity due to *M. johnei* itself is concerned.

In laboratory animals the question of age susceptibility has proved most important; there are indications that early workers failed to produce *M. johnei* infection because they tried to infect *adult* laboratory animals. It has now been shown that infection can be successful if the laboratory animals are young when inoculated. An experiment in progress at Compton is designed to shed further light on this question; black mice of various ages have been inoculated and are being studied.

The Effect of Dose on Susceptibility

Experiments with domestic animals have suggested that comparatively large doses of bacilli are needed to produce Johne's disease, and even using these high doses some individual cattle may be resistant. Rankin (1958b) used a dose of 100 mg. of moist bacilli but, even by the intravenous route 2 of 6 calves inoculated proved resistant. Dr. Rankin and I have an experiment in progress at Compton to find a suitable oral dose of *M. johnei* for infection of cattle. The experiment has so far only run for about 2½ years, but to date only cattle which received oral doses of 200 mg. or higher have developed the clinical disease. Necessity for high doses suggests again that *M. johnei* is not a particularly aggressive pathogen. In nature doses of bacilli of this order are most unlikely to be encountered as a natural hazard, and the animals which do contract Johne's disease are in the minority, considering the herd as a whole. The latter facts indicate that in nature the individual susceptibility of an animal plays a major part. The question regarding susceptibility to symptomless infection of the lymph-node type, as distinct from clinical affection, is less well understood; it is likely that in regard to this type of infection, there is less variance in the susceptibility of individuals.

In laboratory animal work the necessity to use quite high doses of bacilli has also been noted. In Swiss white mice I found that even a dose as high as 24 mg. intraperitoneally, would produce intestinal infection in only a minority of mice (Chandler,

TABLE II
DOSE AND SUSCEPTIBILITY IN C.57 BLACK MICE. Results of Histological Examinations

Dose	6 months sample						9 months sample					
	Liver		Spleen		Intestines		Liver		Spleen		Intestines	
	+ve	−ve	+ve	−ve	+ve	−ve	+ve	−ve	+ve	−ve	+ve	−ve
10 mg.	6	0	6	0	6	0	4	0	4	0	4	0
2 mg.	4	0	4	0	3	1	4	0	4	0	3	1
0·2 mg.	4	0	3	1	1	3	5	1	6	0	0	6
0·01 mg.	3	2	5	0	0	5	0	5	5	0	0	5
0·0001 mg.	0	5	1	4	0	5	0	6	2	4	0	6

1961a). More recently, even using the promising strain of black C.57 mice, I have found, as shown in Table II, that doses less than 2 mg. are unlikely to be satisfactory by this route. The 10 mg. dose produced heavy infections in the intestines, as well as in the livers and spleens, of all mice inoculated. The 2 mg. dose produced infections of the intestine in the majority of the mice, whereas the 0.2 mg. dose produced intestinal infection in only one mouse. Doses below this level were ineffective regarding intestinal infection. It can be said that there were 3 types of dose, "heavy doses" which infected all the mice, "intermediate doses" which affected only those mice which were individually susceptible to this type of dose, and "low doses" which were ineffective in producing intestinal infection even in potentially susceptible individuals. It appears that, with cattle under field conditions, only those doses of the "intermediate" or "low" type are met with, in relation to the individual susceptibility of the cattle.

Strain of M. johnei

One might be tempted to think that differences in apparent susceptibility of cattle in, *e.g.*, different farms or different areas, might be due to differences in the virulence of the strains of *M. johnei* encountered. There is, however, little evidence for or against the occurrence of different strains in cattle (Hole, 1958). There are in existence in laboratories several strains, which have been adapted to grow without *M. phlei* extract and which are avirulent for cattle; these however are, in a sense, artificial strains. In sheep 3 strains of *M. johnei* can cause disease: the bovine type, a pigmented type and one occurring in Iceland; however, there is little evidence that they differ in general pathogenicity.

At Compton we have used 3 strains, one a standard bovine type and 2 reputedly avirulent strains adapted to grow without *M. phlei*, to infect 3 breeds of mice. The results of the experiments are summarised in Table III. It will be seen that apart from a rare finding in the liver, only the standard bovine strain was shown to be infective in any of the 3 breeds of mice. It is of interest that in regard to these 3 strains of *M. johnei*, mice, especially the black breed, act as indicators of infectivity of the strains for cattle.

Route of Infection

Under natural conditions the route of infection is usually believed to be oral, by sucking teats contaminated by faeces, or otherwise ingesting contaminated food or water. It must also be noted that congenital infection has been shown to occur (Lawrence, 1956). Experimentally, cattle may be infected orally or intravenously (Taylor, 1953). Rankin (1958) found that a dose of 5 mg. infected 50 per cent. of calves by the intravenous route; by the oral route, however, it appears that a higher dose may be necessary.

In laboratory animals the intraperitoneal route is commonly used. In an experiment at Compton, groups of the 3 breeds of mice have been infected

TABLE III
INFECTIVITY OF THREE STRAINS OF *M. johnei* IN THREE BREEDS OF MICE. Results of Histological Examinations

Mouse breed	*M. johnei strain*	6 months sample						9 months sample					
		Liver		Spleen		Intestines		Liver		Spleen		Intestines	
		+ve	−ve	+ve	−ve	+ve	−ve	+ve	−ve	+ve	−ve	+ve	−ve
Black C. 57	Standard	5	0	5	0	3	2	3	0	3	0	3	0
	Strain II	0	6	0	6	0	6	0	3	0	3	0	3
	Strain 316 F	1	4	0	5	0	5	0	5	0	5	0	5
Brindle CBA	Standard	3	2	2	3	0	5	4	2	3	3	0	6
	Strain II	0	6	0	6	0	6	0	6	0	6	0	6
	Strain 316 F	0	6	0	6	0	6	1	5	0	6	0	6
Swiss White	Standard	4	2	4	2	0	6	3	1	3	1	0	3
	Strain II	0	5	0	5	0	5	0	5	0	5	0	5
	Strain 316 F	1	2	0	3	0	3	0	6	0	6	0	6

TABLE IV

INFECTIVITY OF *M. johnei* IN THREE BREEDS OF MICE BY DIFFERENT ROUTES Results of Histological Examinations

Mouse breed	Route and dose	6 months sample						9 months sample					
		Liver		Spleen		Intestines		Liver		Spleen		Intestines	
		+ve	−ve	+ve	−ve	+ve	−ve	+ve	−ve	+ve	−ve	+ve	−ve
Black C.57	Oral 10 mg.	0	5	2	3	0	5	0	5	1	4	0	5
	i/p 2 mg.	4	2	6	0	5	1	5	0	5	0	3	2
	i/v 2 mg.	5	0	5	0	5	0	3	0	3	0	3	0
Brindle CBA	Oral 10 mg.	0	6	0	6	0	6	1	5	0	6	0	6
	i/p 2 mg.	6	0	5	1	0	6	6	0	5	1	0	6
	i/v 2 mg.	6	0	3	3	0	6	5	0	3	2	0	5
Swiss White	Oral 10 mg.	0	4	0	4	0	4	0	2	0	2	0	2
	i/p 2 mg.	5	0	3	2	1	4	4	2	3	3	2	4
	i/v 2 mg.	4	0	4	0	1	3	4	0	1	3	0	4

by the intraperitoneal, intravenous and oral routes, as shown in Table IV. It will be seen from the Table that the route of infection plays an important part in the development of lesions. Using the oral route, and a single dose 10 mg. bacilli, minor lesions containing bacilli were produced in the spleens of 3 black mice and the liver of 1 brindle mouse. Using the intraperitoneal route, intestinal lesions were produced, and with the intravenous route higher intensities of infection were obtained. It is of interest that, though the intravenous route was the one of choice in this respect, it was nevertheless not possible to overwhelm the resistance to intestinal infection of the brindle mice.

Other Natural Factors

In addition to those discussed above there are very many factors which may play a part in infection and production of clinical disease. Poor nutrition, poor hygiene and concurrent infection may play a part, as may any form of physiological stress such as heavy milking and calving. Hole (1958) believes that there is no one common predisposing factor, but there may be a factor capable of converting infection into clinical disease.

Artificial Factors

The most obvious artificial factor that can influence the susceptibility of domestic animals to infection is vaccination. The Vallée vaccine appears on the results of field trials to give a practical degree of protection to cattle (Spears, 1959). Sheep can also be protected by vaccination (Sigurdsson, 1954). However, vaccination methods rarely result in complete protection of all animals inoculated and, in the cases of breakdown, factors affecting susceptibility in general may play a part.

No chemical or antibiotic drug has been shown to have a prophylactic or curative effect against clinical cases of Johne's disease. In laboratory mice cortisone has been shown by Ford (1957) and by myself (1961a) to have no enhancing effect on *M. johnei* infection. At Compton we have shown that the drug suramin enhances *M. johnei* infection in mice. The course of *M. johnei* infection is not, therefore, immutable.

Conclusion

One is tempted to think of animals as having a "threshold" for infection with *M. johnei* and development of Johne's disease. The level of this threshold may depend on such factors as age, breed, nutrition and stresses of existence. The threshold may be crossed by such resorts as heavy levels of infection and the use of various routes for infection. The threshold can be raised by such procedures as vaccination. Where an organism such as *M. johnei* is concerned, which may be considered as not a particularly aggressive pathogen, the threshold or susceptibility of the animal is likely to play an important rôle in deciding whether infection will progress to the clinical state.

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THE SPEAKER'S INTRODUCTION

The Chairman, Mr. T. C. Denholm, said that he did not propose to waste a lot of time introducing the speaker. Dr. R. L. Chandler was well known to all present; he was a renowned research worker who had travelled pretty widely over the surface of the globe. He was at present Senior Scientific Officer at the Compton Agricultural Research Council Field Station.

Dr. R. L. Chandler said that he wished to emphasise 2 major points. Firstly, it was suggested in the paper that the susceptibility of an animal to disease was likely to play a greater part when the infectious agent was a relatively non-aggressive one. Susceptibility was influenced by many factors which might be partly divided into those concerned with the suitability of the host as an environment for the organism, and those concerned with the defences of the host against the organism. Obviously, the divisions overlapped each other to a great extent. The degree to which they overlapped was largely a deciding factor of the course of the disease.

In Johne's disease, one gained the impression that although the bacillus was an obligatory parasite, the relationship between bacillus and host might be less close than, for example, the relationship between tubercle and host. Individual susceptibility was likely to play a greater part in such a disease than in diseases caused by virulent pathogens such as cause the great epizootics.

The second point concerned why laboratory animals were of particular importance for use in Johne's disease research. The situation at the moment was that there were several laboratory animals which showed promise as being satisfactory animals for Johne's disease, but so far, there was no laboratory animal yet which had all the properties required for laboratory work on the disease, such as existed in most of the other bacteriological infections. Cattle experiments in Johne's disease often took several years to fulfil, since animals had to be infected as calves and kept until, as adults, they developed the clinical disease. Some animals would live until they were 8 years old before they would show Johne's disease and the expense of keeping large numbers of animals would be obvious. For example, at present, he and Dr. Rankin had experiments being run to ascertain the oral dose of *M. johnei* in cattle, a very elementary sort of experiment which, with any other disease, would have been done 50 or 60 years ago; but the animals would have to be kept on for 3 to 4 years before an indication was obtained of what dose was required to infect them. The finding of a suitable laboratory animal for Johne's disease would enable many more experiments to be done than at present, using larger numbers of animal units, and at less expense. The person who found a suitable laboratory animal would not only be serving science but also the taxpayer's pocket.

Slides were then shown of breeds of mouse, of the results of *post-mortem* examinations on mice, etc. Also tables showing the variations in susceptibility in the 3 breeds of mice—black, brindle and white.

In the paper, he had introduced the word "threshold," since he felt that individual animals might have a threshold for infection with *M. johnei* and development of Johne's disease. The level of the threshold could depend on such factors as age, breed, nutrition and stress. The level of the threshold could be raised by vaccination, and the threshold could be often crossed by using heavy infective doses and different routes of infection.

His comments were made in the hope that they might stimulate discussion of the question, and he hoped that practitioners in the audience would be able to give their valuable views and impressions of Johne's disease as they encountered it under field conditions.

The Opener

The Chairman said that members of the Provisional Committee considered themselves very fortunate in securing as opener Mr. E. J. H. Ford. Mr. Ford was well known for his contributions to scientific literature and was at present Principal Scientific Officer, Institute of Animal Physiology at Cambridge.

Mr. E. J. H. Ford said he wished first of all to offer his sincere congratulations to Dr. Chandler on his paper. It was a result of very careful consideration of the many factors which bore on susceptibility to the infection. Dr. Chandler had done two things: he had dealt in a very thorough way with the results of other workers in the field and he had tied in with those his own contribution; he had demonstrated his own activity by the very volume of his contribution. He had taken his audience right back to the fundamental aspects of the subject. He had shown the difference between black and white mice; showing that they differed not only in colour but in the way in which they accepted or did not accept *M. johnei* in their tissues.

He felt greatly honoured to have been asked by the Committee to open the discussion on Dr. Chandler's paper. When he was first asked, he was puzzled as to why his name was chosen because he was not now an active worker in the field although, some years ago, he had dabbled with the problem and used several species of animal in an attempt to see what happened when one administered *M. johnei*. He hoped that the choice was not forced on the Committee because of any shortage of active workers in the field. He hoped later to return to the question of an adequate volume of work in progress in that field.

His duty was to try to stimulate discussion by provoking comment and questions from members of the audience; these comments and questions should provoke suitable response from Dr. Chandler, in the general hope that their ideas would be clarified on the factors which influenced the susceptibility of animals to *M. johnei*.

By animals must be meant cattle, sheep and goats, the main natural hosts of the infection, together with those various species which had been used in laboratory work. He proposed to deal with Dr. Chandler's paper under the headings the author had used.

Firstly, on the question of species susceptibility, one might also be justified in using the term "host specificity." Dr. Chandler stressed that the ruminant was not only the main natural host but the only natural host. The question must be asked as to why this should be. The first thought that crossed his mind without thinking very deeply was whether there was any relation to the unusual stomach arrangements of the ruminant. Dr. Chandler stressed that the organism being dealt with was a very feeble pathogen on a comparative basis. Why then should a ruminant in particular be susceptible to a feeble pathogen? It was unlikely that the acidity of the gastric contents was a factor because the *p*H of the abomasal contents was close to that of the stomach contents of a monogastric animal.

If, as was recently shown by Payne and Rankin, the tonsil was the prime point of entry of the bacillus into the tissues, the conditions in the stomach and other parts of the alimentary canal were not of great importance. One had therefore to look further and particularly concentrate attention on conditions in the intestinal mucosa, which everyone agreed was the main point of multiplication.

There, comparative studies on tissue metabolism were indicated. Was it possible to study metabolism by tissue cultures and then see what changes might affect the capabilities of the organism to grow in those tissues? Mackaness in 1952 studied the growth of *Mycobacterium tuberculosis* in cultures of microphages and was able to study the response of the organism to a variety of chemical agents. He had come to the conclusion that his results were much more useful than those obtained by the study of cultures on the more classical media. It might be possible to do something along those lines with *M. johnei*.

Dr. Chandler said that there had been no reports of the recovery of the organism from wild rodents: he himself wondered whether anyone had actually looked for the organism in wild rodents; were there any reports of unsuccessful searches?

Next came the question of breed susceptibility. It was satisfying to note that Withers' survey had confirmed a long-standing clinical impression that the Channel Island breeds had an increased incidence of the disease. Had anyone any idea as to the cause of that increased incidence? Was it an increased suscentibility or was it the result of increased exposure to infection? In other words, did herds of Channel Island cattle carry any greater concentration of the organism than those of other breeds?

Dr. Chandler had covered the question of age suscepti-

bility. Had he done any work on the inoculation of the black mice at varying ages?

On the question of dose effect, it was very convenient, when conducting experiments, to give a large dose of bacilli on one occasion by intravenous or intraperitoneal injection. One knew one had got the organism in and that one had got a definite amount in so that results could be carefully compared, but it had to be admitted that that method of challenge was probably very different from the challenge to which the ruminant was exposed in its natural environment.

He personally always imagined that calves were probably infected by a long series of doses of relatively small numbers of bacilli. That was probably also the case in sheep. The disease was known to be prevalent in hill flocks; large numbers of the hill flocks were brought in at lambing time and the lambs were exposed to heavy infection, but it was also a fact that a lot of the flocks lambed on the exposed areas on the hills where the intensity of infection would be low; but nevertheless it occurred. He might be wrong in the idea of the small dose infection and asked for Dr. Chandler's views on that point.

It was encouraging to note that Brotherston and his co-workers at Moredun had studied the development of the disease in sheep and had used 8 consecutive weekly doses. It was also interesting to know that those doses consisted of 10^5 bacteria per dose and that that was confirmed by cultural methods. Lominski and his co-workers estimated that 2 mg. of moist bacteria contained about 5×10^9 bacteria. There was a discrepancy in the figures and it was probably due to the fact that Brotherston used cultural techniques while Lominski used counts on stained smears. The totals needed to set up the disease in laboratory animals were in any case tremendous.

Another point discussed by Dr. Chandler was the strain of *M. johnei* which was capable of setting up the disease. When he was in practice, his impression of the distribution of the disease in the area where he worked was that there was a number of farms that were definitely infected; you could go to the farms from time to time and pick up the odd clinical case. There were the others where no clinical cases occurred. The question that arose from that was whether the particular farms carried a particularly virulent strain of the organism whilst the other farms were not free of the organism but had an organism of less virulence, and probably contained a large number of lymph node carriers.

He was a little doubtful of the value of Dr. Chandler's experiment with his different strains. It would be necessary to carry out comparative experiments using a number of strains recently isolated from clinical cases of the disease in cattle. Also, at the same time it would be necessary to compare a number of strains isolated from cattle which were lymph node carriers to see whether there was any difference in the virulence of the 2 types of organism. The work could also be extended to a study of the 3 strains of the organism which have been shown to cause disease in sheep.

Dr. Chandler's next point concerned the route of infection. There was little doubt that natural infection must be either oral or congenital and the latter probably bore some resemblance to the artificial infection by the intravenous route. He made a plea for closer study of the oral route of infection. The intravenous and intraperitoneal were more convenient routes to use. There were experimental difficulties with the oral route but, with care, those could be overcome. Dr. Chandler himself had shown that, using the oral route in the black mice, results were rather poor. He himself wondered whether the difference was that with intravenous and intraperitoneal infection the defences of the animal were being by-passed, the defences probably being associated with the tissues through which the organism had main access to the body.

Dr. Chandler's final heading was "Other factors"; one could list a great number of factors which might bear on susceptibility to this infection. Now that the black mice had been demonstrated to be susceptible, one could envisage a whole series of experiments which were designed to study the effect of differing planes of nutrition: *i.e.* variations in calorific intake of the diet, high and low protein, high and low carbohydrate, and also deficiencies of the various minerals and vitamins which had been shown to be essential for resistance to disease.

An interesting clinical observation was made in 1950 by Smyth who suggested that calcium imbalance was often associated with clinical breakdown in cattle. He quoted his experiences on the north coast of Cornwall where the land was sandy with a high calcium content and clinical cases of Johne's disease were rare, almost non-existent; yet when the cattle were taken inland to an area of acid granite soil, the disease was frequent. That was a clinical observation but it gave a lead to the sort of thing which could be tested by experimental method. Brotherston's work with sheep could well be developed in that direction.

He himself had had an experience with goats which might have a bearing on the point. He infected a group of animals, some orally, some intravenously; there was no doubt that the organism established itself in the bodies of these animals. Progress was followed by periodic cultures of the faeces; the animals became persistent excretors of the bacilli. Clinically, they were normal. There was no suggestion of breakdown; their condition improved. Because of the lack of clinical cases, it had been decided to turn the animals out. They were put into a small paddock, rather crowded together, and given an adequate diet. As time went on, they lost condition and began to show diarrhoea and a number of deaths occurred. There were typical lesions and high gastro-intestinal parasite counts. Which came first? Did the existence of the Johne's infection, although non-clinical, make these animals more exposed to the parasitic burden or did the parasitic burden develop anyway and encourage the clinical breakdown of the Johne's infection?

The other factor Dr. Chandler mentioned as affecting susceptibility was the administration of suramin; could a possible practical application of that finding be suggested? Had Dr. Chandler done any work on the use of egg yolk in the infection; Pierce and her co-workers found it a valuable enhancing agent to the development of tuberculosis in small animals so that it might have an advantageous effect in the development of the *M. johnei* lesion.

On the question of vaccination and its effect on increasing resistance, he realised that the position had been discussed at length in a Congress paper 2 years ago, but it would be interesting to know whether there had been any changes in the position and in the assessment of the value of the vaccine. He knew that work had been done in an attempt to develop vaccines of a non-sensitising nature, but had any vaccines of an entirely new type been tested?

He had asked many questions and left many of them unanswered. He hoped there would be a lively discussion, both from those members of the audience who had encountered the disease in the field and from those carrying out controlled investigations in the laboratory. The whole subject of Johne's disease was of tremendous importance, the fact that it was discussed by Congress 2 years ago was an indication of that. There was a great deal of work in progress in a number of places. Nevertheless, he made a strong plea for an intensification of research in that field, especially in the University Veterinary Schools and Faculties. He knew there were difficulties, particularly in view of the long-term nature of the work. Post-graduate students with three years or less to complete their work and write a thesis were likely to fight shy of the subject. On the other hand, the subject might appeal to teaching members of the staffs of such institutes, who could run a group of animals over a long period and make their observations at those times of the year when teaching duties were light.

Sir William Slater, when Secretary of the Agricultural Research Council, said that there were ample funds for agricultural research but a shortage of suitably qualified workers. It was up to the profession to show him that the workers were ready and willing to commence, and, in so doing, cast some doubt on the view of the present Secretary, Dr. Cox, who had said that the veterinary profession suffered from the lack of a tradition of research in its teaching institutions.

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The General Discussion

Dr. Chandler said that while Mr. Ford had some doubt as to why he had been chosen to open the discussion, the rest of them had none; he had shown a clear objective view of the problem and had asked many questions. Why were ruminants the main natural hosts. That was a fundamental question which applied to practically every disease which had hosts in a certain group of species. If the answer to that was known, the answer to many disease problems would be nearer. The first thing one thought of was that a ruminant had a ruminant stomach and the disease was of the intestines. Some people had examined that, and although many suggestions had been put forward as to why the ruminant intestine was more susceptible, no one had yet put forward sufficient reasons to account for the susceptibility of ruminants in general. One had to be rather careful with that Lamarckian type of suggestion; one might as well say that all ruminants have horns and perhaps it was something to do with the horns. The question of the ruminant intestines should be thoroughly studied in its special relationship to Johne's disease, for obvious reasons, but other questions such as the serological properties of ruminants and other factors which might be peculiar to ruminants should be studied in addition.

He knew of no searches in wild rodents. That was an example of the work which could well be done by outside organisations. It seemed to be a question that faculties of universities might look into; in particular, it was something the Nature Conservancy might well do.

With regard to age susceptibility a 9-month black mouse would be a pretty adult mouse and he found that when high doses of *M. johnei* were used, such a mouse could certainly be infected. The age resistance as it occurred in mice and in cattle might not be strictly parallel.

On the question of high incidence in Jerseys, there were many reasons which might apply. They might be fundamentally more susceptible for some genetic reasons. They should be careful in not thinking of the Jersey cattle as the black mouse, or even the black sheep, of the agricultural world. The susceptible mice were bred specifically so that infections could be set up in them. Cattle had not been selected under such strict procedures as for the experimental mice in the laboratories. The question of the susceptibility of the Jerseys was a subject which, at Compton, they would like to deal with, as other people would. An obvious preliminary experiment would be a couple of dozen Jerseys and a couple of dozen Ayrshires and a couple of dozen of another breed, inoculate them, house them, feed them, get a government grant to do it and keep them 5 years to find out if it was justified to apply it to field conditions.

With regard to doses, the doses used for experimental animals were pretty high from the bacteriological point of view. It had to be remembered, however, that whereas research workers were trying to infect animals with *M. johnei*, practitioners were trying to prevent them from getting it. He doubted whether, under field conditions, such high doses were met with. He would find it hard to believe that a calf kept on a property in a very well managed farm where the owner was well alive to the dangers of Johne's disease could ingest 2 mg. of bacteria even over a considerable course of time.

Regarding strains of *M. johnei*, Mr. Ford felt that the mouse experiments with artificial strains were not applicable to field conditions; he agreed with that. As he had made clear in his introduction to the paper, the experiments were conducted to see if the artificial non-pathogenic strains which were known to be avirulent in cattle were also avirulent in mice. They were of significance in that context only.

Regarding the possibility of different strains to be found in the field, he had quoted in the paper Mr. Hole, who had great experience in that matter, and had written on one occasion that there was no information one way or the other as to whether there were differences in the virulence of strains in the field. He himself suggested to Mr. Ford that perhaps one of the post-graduate students he asked for might be sent out to collect and make a study of the strains.

The goat experiment sounded interesting; the question of the parasitic infection and the *M. johnei* infection would take a lot of answering; the two infections together might tend to worsen each other.

Suramin was a drug which had been used for 20 to 30 years for the treatment of trypanosomiasis, and it had been found in the field of tuberculosis that suramin increased the susceptibility of laboratory animals to tuberculosis. That was the reason why he had tried it using Johne's disease. The reason why it worked was debatable but in simple terms, the drug affected the surface of the bacteria in such a way that the bacteria were not so affected by the defence cell systems. He had tried suramin, which increased the infection to some degree and he had tried cortisone. In rats, he had also tried splenectomy and direct inoculation into the caecum and on that occasion had been unsuccessful in getting worthwhile infection.

With regard to vaccination, the major experiments in this country were carried out at Weybridge and he felt that if someone present from Weybridge could comment on that it would be more authoritative than if he did so.

Mr. Griffith Jones said that the speakers had invited observations from clinicians in the field and he wished to make one. In the mixed farming area where he practised the farmers could in general be divided into 2 groups: those that were more interested in the arable side of farming and those more interested in their stock. Dr. Chandler had mentioned the threshold to clinical Johne's disease. It appeared that there was a higher incidence of disease in the former group in the practice area, which indicated that where the standard of animal husbandry was lower, the threshold to Johne's disease was also lower.

Dr. Chandler said that the observation was an interesting one. He did not think there was any doubt that people who were aware of Johne's disease and who strove to do something about it in their properties could reduce the incidence to some extent, but there were several properties where a man did everything he could think of and had "ideal" conditions but still could not get the Johne's disease on his property below a certain level.

Dr. A. W. Stableforth (Central Veterinary Laboratory, Weybridge) said that he would like to speak for Mr. Stuart whose present experiments bore on the question of susceptibility which had come up. He was carrying out vaccination experiments at Weybridge with artificially infected animals; groups of 4 animals had been taken, one of which was inoculated intravenously and excreted the *M. johnei* in its faeces, so acting as a donor; the other 3 were, one not vaccinated, one vaccinated once and one vaccinated approximately every year. The groups were replicated many times to get a good cover and the animals had been exposed in the way described to get as near to the natural method of exposure as possible. They were exposed for 2 or 3 months, and the donors taken away. They were just beginning to calve now, and it was quite clear that the Channel Island breeds, chiefly Jerseys, were in fact very much more susceptible than the Friesians and Ayrshires which bore out the fact that it was a matter of real susceptibility and not of exposure, as could be the case in heavily infected herds. He could not remember the exact figures but they were much as follows: amongst the controls, all the Channel Island cattle were already dead or going and only one or two of the other breeds; amongst the vaccinated, several of the Channel Island ones had either broken down or were breaking down, and the Friesians and others up to a few weeks ago were showing little.

Their experience with identical twins was also of interest. For mastitis experiments, they had had for some years a herd of identical twins and out of something like 35 pairs, in 7 cases one animal had broken down from Johne's disease and the other had not. The animals were identical twins and extremely alike; they were usually grazed together.

It was a puzzle, whatever explanation one gave, why Johne's disease occurred in one animal and not the other.

Dr. Chandler said he was most interested in and grateful to hear the results of the vaccination experiments. It was somewhat of a relief to hear from someone that the Jersey cattle were described as being more *susceptible* to Johne's disease rather than that the *incidence* in Jerseys was greater. On the question of like twins and only individuals of the twins in some cases getting Johne's disease, he was not sure whether the infection given to the twins was similar in every case.

Dr. Stableforth replied that no infection was given; it was quite natural in a herd of identical twins being used in another experiment.

Dr. Chandler said that it was obvious that an experiment should be done with identical twins with a controlled and known infection dose to analyse the point.

Dr. E. J. L. Soulsby (Cambridge) said that it appeared that relatively large doses of organisms were necessary to produce infection in experimental animals. Was there any chance that, in order to produce an infection, large numbers of organisms had to be present to induce a state of either immune tolerance or immune paralysis in an animal? The fact that cattle could only be infected as calves would suggest that such a mechanism might operate. Was there any information on the immune response in mice to small doses of organisms as opposed to large doses? In other words, might the small dose be destroyed by immunological means, whereas the large dose might induce immune paralysis.

Dr. Chandler said that in mice, it appeared, on the basis of his own experiments and also on the basis of other workers' experiments, that larger doses were needed for *M. johnei* than were commonly needed in other bacterial conditions.

The question of immune tolerance had been recognised by workers on Johne's disease as being of importance in the disease, not only in laboratory animals but in cattle as well. The point that calves might be infected *in utero* had a bearing on the first part of the question. The difficulty of considering immunity and tolerance in mycobacterial infection was that even in low-grade infections due to *M. johnei* and tuberculosis, there was an allergic response in addition to the other types of response. The analysis of such a question, although of great interest, would be quite a considerable experiment to do. He felt it should be done but so far as he knew, no experiments specifically in regard to tolerance in Johne's disease had, to date, been carried out.

On the question of the difference between the immune response to a small infecting dose as opposed to a large infecting dose, that was an experiment which should be carried out, and perhaps the black mice would give an opportunity for doing it.

Mr. A. Gonsalves (Portugal) asked how soon after the infective dose was administered a positive vaccine test was obtained and whether the serological response and immunological tolerance ran parallel to the degree of infection.

Dr. Chandler said that the work was at a rather early stage; he wished to be sure whether the infection in the first case would infect the mice and whether it would be considered a useful animal at all before he made studies such as serological response and immunological tolerance.

Dr. A. Foggie (Moredun Institute, Gilmerton) asked whether Dr. Chandler would agree that, in addition to those found in the pancreas, the massive infections he found in the livers and spleens of his mice were the results of the intraperitoneal route of inoculation. His colleagues, Mr. Brotherston and Dr. Gilmour, in their work on sheep had found that the primary site of infection was the mucus membrane of the intestine and that infection of the lymph nodes and spleen was secondary and only became heavy in the terminal stages of the disease.

They disagreed with the finding of Dr. Rankin and Dr. Payne that the portal of entry of the infection was the tonsil and thought that the primary infection was intestinal.

Dr. Chandler said that the intraperitoneal route was used in most of the animals. It was obvious, to relate the condition more closely to the field condition, that the oral route would, in some cases be of preference. However, using the oral route, he obtained an occasional infection of the liver and spleen without an intestinal infection. Using the intraperitoneal or intravenous route, infections were obtained in all 3 breeds of mice in the liver and spleen and, in the black mice, the intestines also. He felt there might be a parallel between the infections in the lymph nodes in cattle and the infections in the liver and spleen in mice.

He had been in close contact with the work conducted by Rankin and Payne on the subject of route of infection and pathogenesis of the disease in cattle and saw very little grounds for doubting their suggestion that the lymphatic system was important in primary infection.

Professor D. L. Hughes (University of Liverpool) said that it would seem a far cry from oedema and gastro-enteritis in the pig to Johne's disease, but work that his colleagues Buxton and Thomlinson were doing made one think about Johne's disease. Their suggestions and the increasing evidence they were getting that the lesions in the pig were a hypersensitive reaction between bacterial antigen and possibly fixed tissue antibody might eventually help in understanding Johne's disease; the actual lesions in the clinical case in the bovine animal might be a balance between mycobacterium antigen and the amount of fixed antibody in the bowel. The right kind of balance between such antibodies and the appropriate antigen(s) may be the initial cause of the lesions in Johne's disease.

Dr. Chandler said that the comment was interesting. It had not been dealt with very well in Johne's disease. Similar studies had been made in tuberculosis and in the field of tuberculosis, there had been great debate as to whether an allergic response, which would come under the heading of fixed antibody, was beneficial to the animal concerned. It has been shown, even in some human cases, that if you could remove the allergic response, you could actually improve the condition in certain cases. The allergic response to mycobacterial infection might be harmful to the host which produced it. One point of interest was that it was accepted that, in mice, the production of allergy was different to the production of allergy in humans and cattle, and the use of men and cattle and the study of allergic response in both of them might give some clues to the point Professor Hughes was making. One seemed to get Johne's disease in the intestines of mice similar to the sheep. People accepted that allergic response in mice was of a different nature to that in cattle. It had been shown, in black mice, in tubercular infection, that a degree of allergic response could be demonstrated.

He had done a few experiments at Compton with the Johne's disease infected mice using tuberculin and an intradermal (foot) test and could not, at the stages at which he inoculated them, produce a recognisable allergic response, but people claimed that it occurred in black mice in cases of tuberculosis.

Mr. D. W. Kerruish (Isle of Man Board of Agriculture and Fisheries) asked the speaker whether now that a laboratory animal susceptible to Johne's disease had been found, he intended to attempt the cure of this disease in mice by the use of various drugs. In the absence of any reliable test for Johne's disease it was important that some effort should be made as soon as possible to improve the clinical and bodily condition of animals in the field so that some salvage, at least, might be obtained from the carcases. The Russians had claimed that good results had been obtained by the use of dapsone. In the Isle of Man they had tried out a number of drugs. Dapsone, INH, and succinyl sulphathiazole had been tried on a number of clinical cases which had had positive faeces samples. In many of these cases a considerable clinical improvement had occurred but unfortunately this was merely of a temporary nature and with one exception all of the animals relapsed into their original state.

Dr. Chandler said that one of the reasons why laboratory animals were being looked at was so that experiments could be conducted with antibiotics and therapeutics and vaccines. He hoped that the commercial people present might bear in mind that the black mouse was a possibility

(*Concluded at foot of page* 1215)

The Toxicity of Certain Groundnut Meals for Poultry with Special Reference to their Effect on Ducklings and Chickens

BY

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SUMMARY.—1. *Evidence is presented of the susceptibility of ducklings and chickens to the toxic principle in certain samples of groundnut meal. It is shown that ducklings are highly susceptible to the toxic principle in these meals and suggested that they are eminently suitable for screening suspected samples of groundnut meal and for other experimental work connected with this type of toxicity.*

2. *A toxic agent was found in certain Brazilian and East African groundnut meals, and evidence is presented which suggests that the toxic principle in these meals is identical.*

3. *The gross and microscopic lesions in ducklings and chickens fed on toxic groundnut meals are described and the similarities and differences between the lesions in these birds and turkeys and in large animals is discussed.*

Introduction

DURING the spring and summer of 1960 numerous outbreaks of disease of an unusual nature occurred in turkey poults. Most of them occurred in the south and east of England. The disease received considerable publicity in the local and national press and has been the subject of communications to veterinary journals under the term turkey "X" disease. Blount (1961) has indicated that a toxic factor in Brazilian groundnut meal was responsible for this disease.

The purpose of this paper is to record that domestic avian species other than turkeys are susceptible to the toxic factor, and to indicate that this toxicity is not confined to Brazilian groundnut meal.

History

During the period that losses were occurring in turkeys, several outbreaks of a "new" disease in ducklings came to our notice. Some of the macroscopic changes in ducklings resembled those seen in turkeys but there were additional symptoms, notably lameness and purple discoloration of the legs and feet in some birds. It seemed likely that the disease in ducklings and poults had a common cause.

Suspicion arose that the trouble both in turkeys and ducklings was due to a dietetic factor as a change of food frequently resulted in improvement.

Most outbreaks of the disease occurred in poults and ducklings fed on various proprietary foods, details of the composition of which were not easily obtainable. In August, 1960, we received a report that over 14,000 ducklings had died on one farm during a 4- to 5-week period. In this instance only

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Variations in Susceptibility to Infection with *Mycobacterium johnei*.—*Concluded.*

in that respect as a test animal for testing Johne's disease drugs. To date, none had been tested at Compton.

Regarding treatment of Johne's disease with INH and sulphathiazole he felt that there might be a temporary alleviation of the condition, the use of the drug to control secondary invaders might make the animal live longer. By the time an animal had clinical Johne's disease, the condition was so advanced that it was unfair to expect any drug, even those of the nature available nowadays, to be able to cure such a clinical condition. Enormous doses would be necessary and would have to be given over a long time. Someone would have to come up with a different form of drug, or at any rate a great improvement on the present type of chemotherapeutics or antibodies available, before one could consider that drugs would be of use for the treatment of clinical Johne's disease.

Dr. M. Irfan (Trinity College, Dublin) asked Dr. Chandler if there was any proliferation of endothelioid cells in the spleen and liver of mice experimentally infected with Johne's disease? The pathogenesis in mice seemed to differ from that in cattle. Did the mesenteric lymph nodes in mice show any enlargement especially in those cases where the organisms were given orally or intraperitoneally and the lesions were first seen in the spleen without any infection of the intestines? Also, were the nodes affected in those cases where the gut was involved.

Dr. Chandler said that he had done 3 monthly interval examinations of fairly large numbers of the mice and limited examinations to liver, spleen and intestines, except in occasional cases when he looked at the uterus. He never did studies of lymph nodes of mice; he thought it more important at present to gain a mass of information for future comparative studies.

A point of interest which he had found last week in the laboratory was that he had infected some of the black mice when they were newly weaned, some male and some female, and the breeding of the females fell off at about 6, 7 or 8 months, the females affected with *M. johnei* being regularly mated. By the time they reached 8 to 9 months, few litters were obtained from them. A few had been opened up and some of the uteri had gross *M. johnei* infection and appeared to be completely quiescent. He felt that at any rate uterine infection in the black mice could be procured provided the correct procedure was used. Uterine infection thus can occur and may affect the breeding capacities of the mice. If that could occur in mice, it was possible that the breeding capacity of cattle could be affected by *M. johnei* infection.

The Chairman said that when the paper had been suggested for the Congress, he had had considerable misgivings. He had felt that Johne's disease had been dealt with pretty exhaustively in the recent past and might not go down too well. It was never easy to admit one was wrong but it was very pleasant for him to say that morning that he had been wrong. The paper by Dr. Chandler and the opening by Mr. Ford had been most interesting. The attendance had been good and the contributions to the general discussion had been good. He asked those present to show their appreciation of the paper and the stimulating opening.

home-compounded food had been fed. On enquiry it was found that the protein-rich ingredients of the ration were Brazilian groundnut and fish meals. Both these were immediately withdrawn from the food of the majority of the ducks on the farm and were replaced by soya bean meal and dried milk.

Four pens comprising 800 ducklings were continued on food containing Brazilian groundnut and a further 800 on food containing fish meal but no groundnut. There was a dramatic improvement in all ducklings except those fed on the ration containing Brazilian groundnut meal.

Losses which had also been occurring in turkey poults on this farm ceased when Brazilian groundnut was withdrawn.

During the autumn of 1960 reports were received from Kenya and Uganda of severe losses in ducklings occurring there. The description of the condition was similar to that seen in this country in ducklings fed on diets containing Brazilian groundnut meal. On enquiry it was learned that this ingredient was not present in the rations with which the disease was associated but that they did contain expeller-processed groundnut meal which had been grown in Uganda and Tanganyika and processed locally. When this was withdrawn from the ration, losses ceased (Haig, 1960). Sections of duckling livers were sent to us, and on examination were found to show similar lesions to those seen in ducklings fed on Brazilian groundnut meal in this country. Subsequently, extracts were prepared by Dr. K. Sargeant from certain samples of East African groundnut meal by a development of the method described by Allcroft *et al.* (1961). These proved to be highly toxic to young ducklings and produced the characteristic histological lesions in the liver. There is no doubt that the condition produced by these samples from East Africa is identical to that caused by toxic samples of Brazilian groundnut meal.

The toxicity of Brazilian groundnut meal for chickens was discovered when approximately 30 per cent. of a group of 100 R.I.R. chickens reared from day old at this laboratory on a commercial chick-rearing mash were found to be stunted at 2 weeks of age. It was later determined that the food contained 6.25 per cent. Brazilian groundnut meal. Feeding trials substantiated that this ingredient was toxic for chickens and a number of field outbreaks were later diagnosed in birds sent here for *post-mortem* examination.

Experimental

1. *Ducks*

A sample of Brazilian groundnut meal from the duck farm mentioned above was fed at a level of 10 per cent. to a group of 24 seven-day-old ducklings. The first deaths occurred on the 15th day after the commencement of feeding; by the 26th day, 19 had died. The remaining 5 were small and weakly and were then killed. The average weight of the 7 survivors on the 23rd day was 17.5 oz. A control group of 24 ducklings fed on a similar ration in which Indian groundnut meal was substituted for the toxic Brazilian compound all thrived and had an average weight of 34.3 oz. on the 23rd day.

In a second experiment food containing 10 per cent. Brazilian groundnut meal from 2 different sources, B, and N, was fed to 2 groups each of 32 ducklings 27 days old.

The first death in the group fed on groundnut meal, source B, occurred on the 15th day of feeding and all had died by the 33rd day (10 had died by the 20th day).

In the group fed on groundnut from source N, the first death occurred on the 20th day and by the 44th day, 27 had died. The remaining 5 were weak and stunted. No deaths occurred in a control group of 33 ducklings fed a diet containing 10 per cent. Indian groundnut meal.

A further experiment was designed to determine the degree of susceptibility of younger ducklings to the toxic principle in Brazilian groundnut meal and to compare the effects of different samples.

Twenty-five 2-day-old Khaki Campbell ducklings were divided into 5 equal groups. Three of the groups were fed a mash diet containing 10 per cent. Brazilian groundnut meal from different sacks of the same consignment, sample S. A fourth group was fed on Brazilian groundnut meal obtained from the same firm which supplied sample S, but from a different shipment, termed sample R. The final group was fed on an identical ration except that Indian groundnut meal was substituted for Brazilian.

RESULTS

Sample	Sack	Number of ducklings	Mortality	Days to first death	Days to last death	Mean survival time in days	Remarks
S	D	5	5	6	11	7·2	Typical *post-mortem* lesions and histology
S	F	5	5	12	24	17·0	" " "
S	G	5	5	13	16	15·0	" " "
R	—	5	5	6	13	8·4	" " "
Indian	—	5	0	—	—	—	Fed for 3 weeks. Killed. No lesions on *post-mortem* examination or histologically

2. *Chickens*

Ten per cent. Brazilian groundnut meal was included in a chick mash and fed to a group of 38 day-old R.I.R. chicks. A control group of 38 chicks was fed an identical diet except that Indian groundnut meal was used in place of Brazilian. During a period of 6 weeks there was no mortality in either group, but at the end of this time the chicks fed on the diet containing Indian groundnut weighed 20 per cent. more than those on the food containing Brazilian groundnut meal.

In a second experiment a group of 45 day-old R.I.R. chicks was fed on a diet containing 15 per

F. D. ASPLIN AND R. B. A. CARNAGHAN.—THE TOXICITY OF CERTAIN GROUNDNUT MEALS FOR POULTRY WITH SPECIAL REFERENCE TO THEIR EFFECT ON DUCKLINGS AND CHICKENS

PLATE I.—Nodular hyperplasia of the liver in an 8-week-old duckling.

PLATE II.—Subcutaneous haemorrhage in shank and web of a duckling aged 5 weeks.

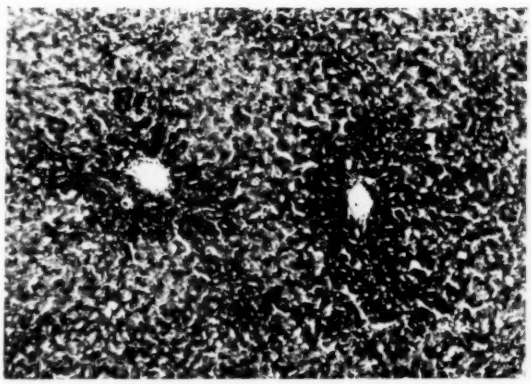

PLATE III.—Liver of a 6-day-old duckling showing proliferating bile-ducts radiating from the portal tracts (×80).

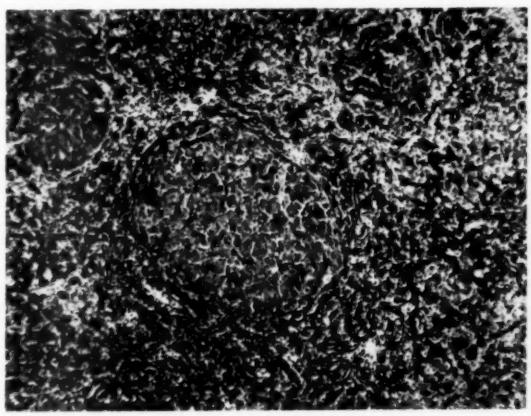

PLATE IV.—Duckling liver ×80. Islands of normal parenchymal cells surrounded by dense masses of bile-duct epithelium and fibrous tissue.

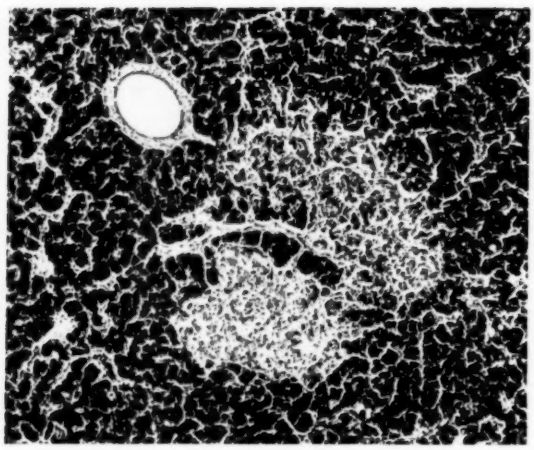

PLATE V.—Duck pancreas ×80 showing areas of acinar degeneration.

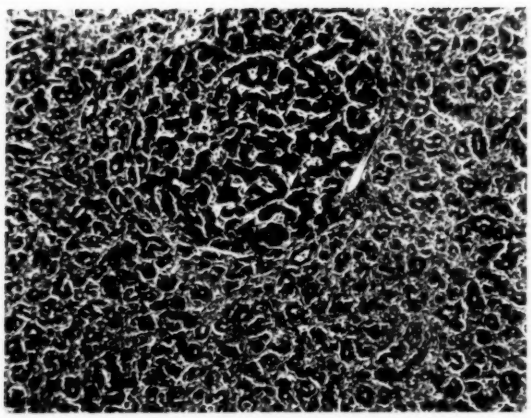

PLATE VI.—Liver of a 4-week-old chicken ×80 showing an island of normal parenchymal cells surrounded by regenerating parenchymal cells arranged in ductular fashion.

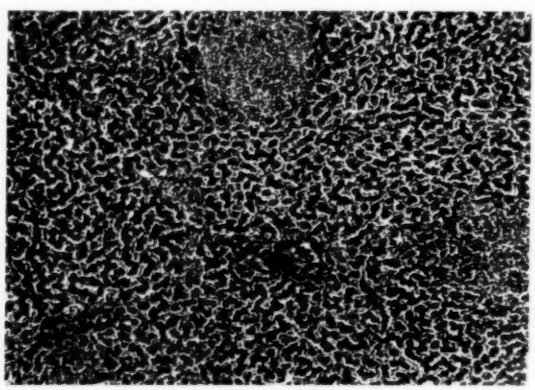

PLATE VII.—Liver of chicken aged 4 months showing lymphoid hyperplasia (×80).

cent. Brazilian groundnut meal for 9 months. Four chicks died during the first 3 weeks, but no further deaths occurred and no clinical signs were observed during the experimental period. The egg production of this batch of birds was regarded as normal for the breed and age. Birds were killed at intervals to study the pathology of the condition.

The samples of Brazilian groundnuts used in these experiments were from consignments found to be highly toxic for ducklings.

Symptoms

In field outbreaks of disease in ducklings there has been an interval, which may be as long as 2 weeks or more between the commencement of feeding toxic groundnut meal and the onset of mortality. This interval seems to be influenced by the toxicity of the sample, the amount consumed and the age of the ducklings.

The first signs of disease are inappetence and poor growth rate. Ducklings may start to eat and then lose interest in the food. The crop is not well filled. A cry indicating discomfort may be heard. There appears to be an increased tendency towards down or feather pulling. A conspicuous feature occasionally seen in white-skinned older birds is a purple discoloration of the legs and feet. Ducklings showing this lesion are often severely lame. It has not been seen in birds under 3 weeks of age.

Young ducklings develop ataxia followed by convulsions shortly before death and die in opisthotonus.

Gross Lesions

1. *Ducklings*

These vary according to the toxicity of the sample which is related to the survival time and with the age of the birds. In recently hatched ducklings dying within a week of feeding the toxic groundnut the liver is putty-coloured and slightly enlarged. The kidneys may be pale, slightly swollen and contain a few diffusely scattered haemorrhages. Petechial haemorrhages are frequently present in the pancreas. In young ducklings surviving to about 3 weeks of age the liver changes become more pronounced. A pale reticulated network is seen throughout the liver substance and this is associated with a shrinkage in size and a progressive firmness in texture. Coinciding with this cirrhosis, hydropericardium and ascites may be present in varying degrees although never severe. Haemorrhages in the pancreas and kidneys are present but do not appear to be more marked than in younger specimens.

In older ducklings which generally survive for longer periods the liver cirrhosis is more marked and eventually progresses to the stage of nodular hyperplasia (Plate I). The gall-bladder is usually distended. Hydropericardium and ascites may be more pronounced than in younger birds. Petechial haemorrhages occur in the pancreas and larger and more diffuse haemorrhages in the kidneys. These organs may be slightly swollen but this feature has never been so pronounced as it is in turkeys.

A distinctive lesion in older birds is severe subcutaneous haemorrhage in the unfeathered part of the leg and web causing a purplish discoloration in white-skinned birds (Plate II). A gelatinous subcutaneous exudate may be present in older ducklings which have been fed the toxic groundnut for a long period.

There are no apparent changes in other organs or in the intestines.

2. *Chickens*

In the small number of chickens which died in the first 3 weeks of the feeding experiments the liver was pale in colour and firm in texture and the kidneys were pale and slightly enlarged. In birds that were killed during the following 3 months the liver and kidney changes were similar but more marked. In those killed at later periods these organs were normal in texture and colour but discrete white pinpoint lesions were consistently found in the liver. There were no other noticeable lesions present.

Histological Findings

Material was fixed in 10 per cent. formol saline and paraffin sections prepared and stained with haematoxylin and eosin.

1. *Ducklings*

The principal changes occur in the liver. Diffuse degenerative changes are found in the parenchymal cells. These cells become swollen and vacuoles are present in many. The nuclei are enlarged and karyorrhexis and karyolysis occur. Concurrently, rapid and extensive proliferation of bile duct epithelium takes place, being seen as cords of markedly basophilic cells forming tubules radiating from the portal tracts. This change is clearly visible within 6 days of feeding a ration containing 10 per cent. Brazilian groundnut meal (Plate III). As the condition progresses bile duct proliferation proceeds rapidly until, after a period of about 3 weeks on the diet, only small islands of apparently normal parenchymal cells remain separated and surrounded by dense masses of bile duct epithelial cells and fibrous tissue (Plate IV). Phlebitis is present in varying degrees and in some cases may be so severe as to cause obliteration of the lumen of some of the vessels.

In the pancreas, diffuse areas of acinar degeneration are invariably present. The acinar cells are swollen and show karyorrhexis with a disappearance of their characteristic staining characteristics (Plate V).

In the kidneys, multiple and diffuse haemorrhages in the interstitial tissue are a constant feature but the glomerular changes which were described in turkeys (Siller & Ostler, 1961) are not seen in ducklings.

No lesions were seen in other organs.

2. *Chickens*

In the liver, retrogressive and regenerative parenchymal changes occur similar to those seen in turkeys, but the cells are not so basophilic as those in ducklings when stained with haematoxylin and eosin (Plate VI). This persists until the birds are between

3 and 4 months of age when lymphoid hyperplasia occurs particularly in those areas where regenerative cells are still active. By 4 months no evidence of parenchymal cell regeneration is seen, but multiple circumscribed areas of lymphoid hyperplasia are found scattered throughout the liver (Plate VII). These do not appear to increase in number or size in birds examined up to 9 months of age.

Acinar degeneration of the pancreas occurs and the renal changes are similar to those in ducklings. These lesions were consistently present in chickens throughout the experimental period of nine months.

Discussion

The publicity given to the toxicity of certain samples of groundnut meal for birds has hitherto been related to their effect on turkeys (turkey "X" disease). The results of field observations and feeding trials reported here indicate that ducklings are highly susceptible to the toxic factor in certain groundnut samples and comparison with reports of feeding trials with turkeys (Blount, 1961) indicate that they succumb to the effects more rapidly, and on rations containing lower levels of toxic groundnut meal than do turkey poults. The experimental feeding results indicate that recently hatched ducklings are more susceptible than older birds, and also illustrate the variation that occurs in the toxicity of different samples of Brazilian groundnut meal and between different sacks of the same consignment.

The rapidity with which the proliferation of bile duct epithelium occurs, and the intensely basophilic properties of these cells when stained with haematoxylin and eosin renders histological examination and confirmation of the disease more rapid and easier than in turkey poults or chickens. The only other condition of which we are aware which causes bile duct proliferation in ducklings is duck virus hepatitis (Fabricant *et al.*, 1957). Virus was not recovered from a number of field outbreaks of groundnut poisoning in ducklings investigated by one of us (F. D. A.).

On the basis of these facts it is suggested that young ducklings are the most suitable animals for the screening of suspected toxic groundnut samples either by feeding trials or by the individual administration of extracts of such meals. The latter procedure has been successfully carried out in the course of attempts to identify the toxic principle (Sargeant *et al.*, 1961).

The history, gross pathology, histopathology and the use of chemical extracts have proved that a toxic agent similar to that found in Brazilian groundnut meal is present in certain samples of expeller-processed groundnut meal grown in Uganda and Tanganyika. Whether the fact that this toxicity was first observed in 1959 and 1960 in both Brazilian and East African samples is due to some factor common to both crops is under investigation.

The effect of toxic groundnut meal on chickens is of interest in that the mortality produced is low compared with that in ducks and turkey poults and also that the microscopical hepatic changes alter rapidly as the birds approach maturity. Initially the degenerative and subsequent regenerative parenchymal cell changes are similar to those seen in turkeys but, whereas in this species they persist and have been observed several months after ceasing feeding toxic groundnut meal (Carnaghan, 1960), in chickens they are replaced by a lymphocytic reaction.

The experimental results of feeding trials with chickens indicate that the main effect is retardation of growth. They are more susceptible to the toxic factor when they are young, and later they develop a high degree of tolerance to the toxic principle.

Siller and Ostler (*op. cit.*) described renal changes affecting the glomeruli in turkeys dying from "X" disease. These have not been observed in ducklings or chickens, and are not a feature in calves or pigs poisoned with toxic groundnut meal (Loosmore & Markson, 1961; Loosmore & Harding, 1961). The macroscopic enlargement of the kidneys in turkeys which is a constant feature in field cases, and the glomerular changes in this species, are therefore inconsistent with the lesions seen in other domestic avian species and in mammals. It is suggested that this may be due to the widespread practice of including sulphaquinoxaline in turkey rations and that it is this, possibly in combination with the groundnut toxic principle, which is responsible for the kidney lesions in turkeys. There is some support for this suggestion in that Blount (*op. cit.*) found that rations containing Brazilian groundnut meal and sulphaquinoxaline were more toxic to poults than those containing Brazilian groundnut meal but without the coccidiostat.

The similarity of the histological liver lesions in turkeys fed on toxic groundnut meal to those produced in experimental seneciosis in fowls (Campbell, 1956) and the similarity of the symptoms and microscopic liver lesions in calves poisoned with toxic groundnuts to ragwort poisoning (Loosmore & Markson, *op. cit.*) is striking. However, the histological liver lesions described in ducklings fed on *Senecio jacobea* and *Senecio vulgaris* (Dahme and Müller, 1955) are different from those described in this paper.

Furthermore it was found by one of us (R. B. A. C.) that dosing 4-day-old ducklings with a single dose of 80 mg. per kg. of monocrotaline, one of the pyrrolizidine alkaloids of *Crotolaria retusa*, failed to produce the liver lesions associated with dosing extracts of toxic groundnut meals. A single dose of 80 mg. per kg. was found to be acutely toxic to weanling rats (Schoental, 1961).

Allcroft *et al.* (*op. cit.*) have shown that samples of toxic Brazilian groundnut do not contain either pyrrolizidine alkaloids or the N-oxide of such alkaloids.

Acknowledgments.—Thanks are due to Mr. N. C. Lacey for the microphotographs, to Mr. J. C. Thompson for technical assistance, and to Dr. R. Schoental who kindly supplied the monocrotaline.

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The Assay of a Toxic Principle in Certain Groundnut Meals

BY

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AND

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SUMMARY.—1. *The toxic principle in certain samples of Brazilian groundnut meal has been extracted and concentrated* 250 *times on a weight basis.*

2. *This extract has produced mortality in ducklings and turkey poults and histological liver lesions identical to those seen in field outbreaks of so-called turkey "X" disease.*

3. *The dosing of concentrated extracts to young ducklings gives a rapid and sensitive method for testing the toxicity or otherwise of groundnut meals.*

4. *The toxic principle is neither a pyrrolizidine alkaloid nor the N-oxide of such an alkaloid.*

Introduction

DURING 1960 severe mortality occurred in turkeys aged between 3 and 20 weeks fed on proprietary and home-compounded rations. Losses were heaviest in poults between 3 and 6 weeks of age. Mortality in affected groups was variable but extended to 100 per cent. in some batches when the diet was unchanged. In all, some 500 outbreaks of this disease, which was termed turkey "X" disease, were diagnosed and it was estimated that more than 100,000 turkeys died (Blount, 1961). Ducklings and young pheasants were affected with a similar condition and heavy mortality was experienced by many rearers. Chickens fed diets similar to those which affected turkeys, ducklings and pheasants, showed retarded growth but low mortality.

Suspicion arose that the cause was dietetic in origin as it was observed that a change of food frequently resulted in reduced mortality and a general improvement in condition in the affected group.

Asplin and Carnaghan (1961) investigated the disease on a farm in East Anglia where 14,000 ducklings had died during a period of 4 to 5 weeks. On this farm only home compounded rations had been fed, the protein-rich ingredients being Brazilian groundnut meal and fish meal. Both of these ingredients were withdrawn from the food of the majority of the ducks on the farm and replaced by soya bean meal and dried milk.

Four pens comprising 800 ducklings were maintained on the ration containing Brazilian groundnut meal and a further 800 ducklings on food containing fish meal but no groundnut. There was a dramatic improvement in the second group while mortality continued in those being fed Brazilian groundnut meal. Losses which had also been occurring in turkey poults on this farm ceased when Brazilian groundnut meal was withdrawn.

Blount (1961) examined the incidence of the disease in turkey poults in a number of areas and showed the common factor to be Brazilian groundnut meal in the rations.

During August, 1960, it was generally agreed among those investigating the disease that Brazilian groundnut meal was likely to be the causal factor. Consequently, most of the large proprietary food manufacturers ceased to use this meal in poultry rations. However, substantial quantities of Brazilian groundnut meal had been imported into this country during the latter part of 1959 and 1960, and considerable stocks still remained. Investigations into unexplained illness and deaths in pigs, calves and store cattle showed that the toxic meal was being used in large-animal rations (Loosmore & Harding, 1961; Loosmore & Markson, 1961; Clegg, 1961).

Blount (1961) carried out an intensive search for toxic agents in samples of Brazilian groundnut meal in the course of which a number of specialist laboratories were consulted. The results of this work failed to disclose the presence of any specific known poisonous agent in significant amounts.

Allcroft and Carnaghan (1960) prepared a toxic extract from samples of Brazilian groundnut meal; this work has since been extended and developed in collaboration with the Tropical Products Institute (Allcroft, Carnaghan, Sargeant & O'Kelly, 1961).

The purposes of this article are to give a more detailed account of the work reported in our previous communication and to describe the results of subsequent experiments.

Materials and Methods

1. *Sources of the Meal*

The Toxicity of Certain Groundnut Meals for Poultry. —*Concluded.*

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(a) *Brazilian groundnut.* Several tons of 2 separate consignments of meal in 1-cwt. sacks were obtained from an agricultural supplier. Meal from these consignments had been used in compounded rations which were toxic to turkey poults. Samples of meal for extraction were taken from different sacks so that possible variations in toxicity from sack to sack could be observed. The fat content of these two consignments averaged about 1 per cent. by weight.

(b) *Indian groundnut.* This came from a supply of 14 tons of expeller groundnut meal obtained in 1-cwt. sacks from an agricultural supplier in 1959. Some of this had been fed for several months to heifers which were used in an experiment unrelated with this communication. The growth and general condition of these animals were normal (Littlejohn & Lewis, 1960). The fat content of the meal averaged about 7.5 per cent. by weight.

2. *Chemical*

(a) *Extraction of Brazilian groundnut meal.* Eight hundred g. of meal were continuously extracted with methanol for 18 hours in a Soxhlet apparatus. Removal of the solvent from this extract under reduced pressure gave about 100 g. of a black oily residue (A).

The extracted meal was dried, ground more finely and re-extracted with methanol for a further 18 hours. Only a small additional quantity of methanol-soluble material was removed in this way. The exhaustively extracted meal was air-dried and completely freed from solvent in a vacuum desiccator over phosphorus pentoxide to give meal B.

The residue A was dispersed in 400 ml. of water and the resultant mixture was continuously extracted with chloroform for 3 hours. Removal of the chloroform under reduced pressure gave about 12 g. of a black treacly residue (C). The aqueous layer was concentrated under reduced pressure until all the residual chloroform was removed to give a dark brown aqueous suspension (D).

The residue C was dissolved in a mixture of 50 ml. light petroleum b.p. 40° to 60°, and 50 ml. methanol to give a dark brown solution. Five ml. of water were added and the mixture was vigorously shaken. Two liquid layers formed in addition to a small amount of brown interfacial precipitate. The lower liquid layer was separated, washed with two 25-ml. portions of light petroleum b.p. 40° to 60°, and evaporated to dryness under reduced pressure to give about 3 g. of a brown solid residue (E). The petroleum washings were combined with the upper liquid layer and the interfacial precipitate, and evaporated to dryness under reduced pressure to give a black oily residue (F).

The procedure is summarised in Fig. 1.

(b) *Preparation of a basic extract from Brazilian groundnut meal.* The methanol-soluble residue A, derived from 400 g. of meal, was dispersed in 400 ml. of N/10 hydrochloric acid and continuously extracted with chloroform for 8 hours. Removal of the chloroform under reduced pressure gave about 6 g. of a residue (G). The chloroform-extracted acidic

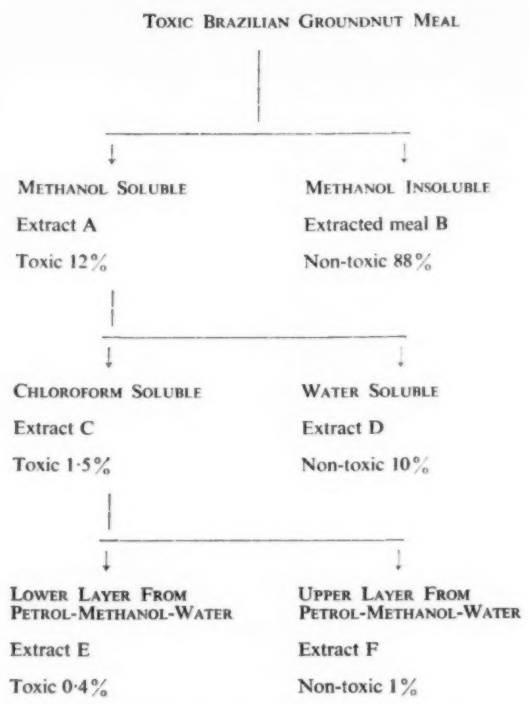

FIG. 1.—Diagramatic scheme of the fractionation procedure showing materials obtained and the approximate percentage by weight of the original meal.

solution was made strongly basic by the addition of 15 ml. of 5N ammonium hydroxide solution, and extracted continuously with chloroform for 8 hours. Removal of the solvent from this extract under reduced pressure gave about 0.5 g. of a residue (H).

(c) *Preparation of a basic extract from Brazilian groundnut meal, following reduction of the toxic residue E.* The toxic residue, E, derived from 800 g. of meal was dissolved in 80 ml. of 2N sulphuric acid and treated with 20 g. of zinc dust. The mixture was shaken intermittently for 6 hours and allowed to stand for a period of 2½ days. It was then filtered and the filtrate was extracted wih chloroform (5 × 40 ml.). The aqueous, acidic solution was treated with an excess of 5N ammonium hydroxide solution and extracted with chloroform (5 × 40 ml.). Removal of the solvent under reduced pressure from the basic chloroform extract gave a trace of residue (J).

(d) *Extraction of Indian groundnut meal.* This was processed in the same way as the Brazilian meal. Two extracts, K and L, similar to extracts A and E respectively were thus obtained. The Indian meal contained considerably more oil than did the Brazilian meal. Extract L, however, was largely oil-free and therefore was obtained in about the same proportion as extract E.

(e) *Preparation of extracts for dosing.* In every case the extract was prepared for dosing in aqueous solution or suspension. In different experiments the

actual amount of a given extract obtained varied somewhat, probably because the meal was not homogenous. However, for all the biological work the residues were made up to a stated concentration relative to the original meal. Extracts A and C could not be made up at very high concentrations, but it was possible to obtain Extract E in suspension at the high concentration of 1 ml. equivalent to 40 g. meal.

3. *Biological*

(a) *Experimental animals.* As a result of feeding trials it was found that young ducklings were more susceptible to the toxic principle than were turkey poults or chicks (Asplin & Carnaghan, 1961), and it was therefore decided to use them for the testing of extracts. Day-old Khaki Campbell ducklings were generally used for these experiments but in some cases older birds were used.

The experimental birds were housed in Cope and Cope electric brooders and fed on a proprietary chick mash. Control groups were kept in the same brooder for each batch of extracts tested.

(b) *Administration of extracts.* The extracts were administered individually to groups of ducklings by dosing them into the lower part of the oesophagus through a thin polythene tube attached to a hypodermic syringe. In the majority of experiments this was carried out daily for up to 5 consecutive days, any survivors being killed on the eighth day. After dosing, the birds were kept from their food and water for one hour to avoid regurgitation into their common food supply.

(c) *Feeding experiments.* Feeding experiments with ducklings were carried out using 2 samples of Brazilian groundnut meal (1 and 2), one sample of exhaustively extracted Brazilian meal (Fig. 1, B) and 2 samples of non-toxic Indian groundnut meal (3 and 4). Results are shown in Table III.

(d) *Criteria of toxicity.* Mortality was recorded and livers from all groups were fixed in 10 per cent. formol saline, and stained with haematoxylin and

TABLE I
DOSING EXPERIMENTS: DUCKLINGS

Extract	Concentration equivalent: g. meal to 1 ml. extract	Age of ducklings in days	Period of administration. Days	Deaths per number of ducklings dosed	Average lethal dose ml.	Total dose ml.	Lesions	Remarks
A (4)	2	1	9	4/4	3	—	++++	
A (92)	2	1	4	4/4	5	—	++++	
C (12)	4	5	7	5/5	2·9	—	++++	
C (93)	4	1	3	4/4	2·5	—	++++	
D (58)	4	1	5	0/5	—	5·0	Nil	
D (94)	4	1	5	1/4	—	5·0	Nil	1 accidental death
E (61)	22	1	1	4/4	0·5	—	++++	
E (62)	7·33	1	2	4/4	0·63	—	++++	
E (63)	2·44	1	3	4/4	1·1	—	++++	
E (64)	0·81	1	4	4/4	1·9	—	++++	
E (64A)	0·27	2	5	0/5	—	2·5	+++	
E (64B)	0·09	2	5	0/5	—	2·5	+	
E (64C)	0·03	2	5	0/5	—	2·5	1+,3 Nil	
E (81)	40	2	1	4/4	1·0		++++	
E (82)	13·3	2	1	4/4	1·0		++++	
E (83)	4·4	2	3	4/4	2·1		++++	
E (84)	1·5	2	5	2/4		5·0	++++	
F (85)	0·5	2	5	0/4		5·0	+++	
E (86)	0·17	2	5	0/4		5·0	+	
E (87)	0·06	2	5	0/4		5·0	1+,3 Nil	
F (36)	8	4	5	0/5		2·5	+	
F (46)	8	3	5	0/5		2·5	1+,4 Nil	
G (5)	4	1	4	5/5	1·2		++++	
G (5)	4	7	8	5/5	4·6		++++	
G (115)	4	3	4	4/4	3·5		++++	
H (6)	4	1	13	0/5		10·0	Nil	
H (116)	4	1	5	0/5		5·0	Nil	
J (149)	160	2	4	0/5		1·0	Nil	
L (76)	40	2	5	1/5		5·0	Nil	1 accidental death
L (89)	40	1	5	0/5		5·0	Nil	

eosin for histological examination. In those groups of ducklings which died within 1 or 2 days of dosing the histological changes consisted of massive necrosis of the liver parenchymal cells with diffuse haemorrhages throughout the liver. When these experiments were repeated at lower dosage rates or in older ducklings, the characteristic proliferation of bile duct epithelium described by Asplin and Carnaghan (*op. cit.*) was found.

Similar lesions were seen in the livers of ducklings dying 3 days or more after the commencement of dosing with toxic extracts.

Both types of histological change were accepted as positive evidence of the toxicity of the extracts. Lesions were assessed on an empirical basis using symbols +, ++, +++, ++++ to indicate severity.

(e) *Experiment with turkey poults.* To show that turkey "X" disease and the condition in ducklings were due to the same agent, extract No. 92 was administered at different dosage rates to 2 groups of 6 day-old Broad Breasted White turkey poults by the same method used for ducklings.

Results

The toxic and non-toxic materials obtained during the fractionation procedure are shown in Fig. 1 together with the approximate percentage by weight of the original meal from which they were derived. The results of the biological tests are given in Tables I, II and III. The numbers in brackets following the extract reference letters, indicate the particular extract used in the tests.

Discussion

Practically all the toxic material present in the Brazilian groundnut meal was concentrated in an extract (E) which represented only 0.4 per cent. by weight of the original. This extract could readily be made to give a uniform suspension in water such that 1 ml. was equivalent to 40 g. of meal. Ducklings receiving 1 ml. of this suspension died in less than 24 hours and the suspension was lethal at much lower concentrations (see Table I). Ducklings which received a sub-lethal dose of extract E equivalent to less than ½ gramme of meal were found on histological examination to have developed the characteristic liver lesions.

Our Indian meal did not contain the toxic substance present in the Brazilian meal since individual ducklings tolerated an amount of extract L (analogous to extract E) derived from 200 g. of Indian meal given over a 5-day period, and showed no liver lesions when examined histologically (see Table I).

We have prepared extracts similar to extract E from a number of samples of groundnut meals and poultry rations, both toxic and non-toxic, and on administration to ducklings have always obtained results which were in agreement with those of the much more lengthy feeding experiments. Even though turkey poults were found to be less susceptible to the extract prepared from toxic groundnut meal than ducklings, histologically the liver lesions were identical with those seen in field outbreaks of turkey "X" disease.

It has been shown that the toxic substance is neither a pyrrolizidine alkaloid nor the N-oxide of such an alkaloid (Allcroft *et al., op cit.*). This was established by the fact that the basic extracts prepared both before and after reduction (extracts H and J) were non-toxic (see Table I). The toxic material was not basic and could be quantitatively extracted from acidic solution with chloroform (extract G, Table I).

The origin of the toxic substance is unknown but it could be derived from a micro-organism, possibly

TABLE II
DOSING EXPERIMENT: TURKEYS

Extract	Concentration equivalent g. meal to 1 ml. extract	Age. Days	Period of administration. Days	Deaths per number of turkeys dosed	Average lethal dose ml.	Lesions	Remarks
A 92	2	1	14 (1 ml. daily)	6/6	9·5	++++	Histological liver lesions as described by Siller & Ostler (1961)
	2	1	20 (0·5 ml. daily)	6/6	*	++++	

* Total dose administered was 10 ml. All deaths occurred between the 21st and 32nd day after commencement of dosing.

TABLE III
FEEDING EXPERIMENTS: DUCKLINGS

Ration	Age of ducklings at start. Days	Deaths per number of ducklings fed	Mean survival time. Days	Total period on ration. Days	Lesions
1. Chick mash containing 10% Brazilian groundnut meal 1. ...	5	6/6	8·4	10	++++
2. Chick mash containing 10% Brazilian groundnut meal 2. ...	2	5/5	17	25	++++
3. Chick mash containing 10% Brazilian groundnut meal 1 extracted to exhaustion with methanol (Fig. 1, B) ...	1	0/5	—	21	Nil
4. Same as ration 3	1	0/5	—	15	Nil
5. Chick mash containing 15% Indian groundnut meal 3 ...	2	0/6	—	18	Nil
6. Chick mash containing 15% Indian groundnut meal 4 ...	11	0/6	—	24	Nil

The Victoria Veterinary Benevolent Fund

A meeting of the Council of the Fund was held at College House, Wright's Lane, London, W.8, on July 20th, when the following members were present:—

Mr. H. W. Dawes (President) in the chair, Messrs. G. F. Brown, E. Clark, Major J. J. Dunlop, Mrs. D. I. Glover, Mr. A. A. Lamont, Professors R. Lovell, J. McCunn, Messrs. N. P. Male, W. J. B. Robson, Miss V. Tillemont-Thomason, Mrs. Erica I. Thomson and Capt. Wm. Watt.

Welcome to New Member

The President extended a warm welcome to Mrs. E. I. Thomson, who was present as one of the 10 members of the Fund elected at the Annual General Meeting held last May.

Minutes

The Minutes of the previous meeting held on April 20th, 1961, having been published in THE VETERINARY RECORD, were taken as read and signed as correct.

Apologies for Absence

Apologies were received from the following members: Professor G. F. Boddie, Messrs. H. E. Bywater, J. T. R. Evans, Mrs. M. I. Field, Professor C. Formston, Mr. J. A. Flynn, Dr. R. E. Glover, Messrs. G. N. Gould, J. M. Ingram, Professor H. G. Lamont, Mr. D. H. L. Madden, Professor A. Messervy, Capt T. M. Mitchell, Professor L. P. Pugh, Sir John Ritchie, Major C. W. Townsend, Professor W. L. Weipers, Capt. A. Whicher, Mr. E. Wilkinson and Major W. H. Wortley.

Correspondence

The secretary reported the following communications:— (a) Letter from Mrs. Dorothy W. Priston enclosing £100 in memory of her late husband, Major W. H. Priston; (b) Letter from Messrs. A. & L. Goodbody, Solicitors, Dublin, intimating that the late Mr. Charles F. Parsons, M.R.C.V.S., had left to the Fund a legacy of £100.

Treasurer's Report

The treasurer reported that, with the concurrence of the executive committee, he had invested £588 11s. 9d. of the balance accumulated in the Donations Account in the purchase of £600 New Zealand 6 per cent. Government Stock, redeemable on November 15th, 1972. *It was resolved* that the action of the treasurer be confirmed.

Accountant's Report

The secretary read the following report which was approved, a vote of thanks being accorded to the respective donors:—

Since the previous meeting, the following legacy and donations had been received—

	£ s. d.	£ s. d.
Legacy		
Parsons, C. F.		100 0 0
Life Membership		
Evans, J. T. R.		10 10 0
Collecting Boxes		
Central Veterinary Society (3 meetings)	7 7 8	
Dumfries & Galloway Division ...	8 11 2	
Eastern Counties Veterinary Society	9 8 10	
Essex Veterinary Society	2 17 0	
North of England V.M.A.	5 6 0	
Royal Veterinary College Students	2 10 0	
Scottish Branch, B.V.A.	2 15 0	
Western Counties Veterinary Association	3 5 6	
		42 1 2
Donations		
In memory of E. F. Lewis (3 subscribers)		11 10 0
In memory of A. B. MacIntyre (12 subscribers)		30 0 0
In memory of W. H. Briston (from Mrs. D. W. Priston)		100 0 0
Governing Council of the Cat Fancy (Mrs. M. Sheppard)		5 5 0
Dobie, T. A.		1 1 0
Evenley Women's Institute (E. A. Tutton)		1 1 0
Glover, Dr. R. E.		5 5 0
Lakeland Veterinary Society ...		25 0 0
McKay, W. M.		11 0
North of England V.M.A. Dinner/Dance	31 3 3	

The Assay of a Toxic Principle in Certain Groundnut Meals.—*Concluded.*

a fungus. Work is continuing in attempts to isolate and identify this toxic principle.

Addendum

Since this paper was prepared for publication we have found that a toxic principle similar to that found in certain samples of Brazilian groundnut meal is present in some groundnut meals from India, Uganda and Tanganyika, French West Africa, Nigeria, Gambia and Ghana. We wish to emphasise that we do not know the extent to which groundnuts from Brazil, or the other countries referred to, are affected.

Acknowledgments.—We are grateful to Mr. C. W. Clarke, Mr. J. C. Thompson, Mr. C. A. W. Garland and Miss H. Brown for technical assistance.

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SILLER, W. G., & OSTLER, D. C. (1961). *Ibid.* **73.** 134.

North of England V.M.A. Donations	3	11	0		
				34	14 3
Pony Club (Wimbledon) (G. W. Serth)				1	1 0
Royal (Dick) Veterinary School Students' Annual Ball				5	5 0
Smith, D. L.					11 0
Society of Practising Veterinary Surgeons				25	0 0
Society of Women Veterinary Surgeons				5	0 0
Warwickshire Agricultural Society				5	5 0
Whicher, A.					10 6
Windsor Championship Dog Show (Willett & Boyde and others) ...				10	10 0
Yorkshire County Cat Show (C. D. Honhold)				2	2 0
				£422	2 11

Subscriptions under Deed of Covenant

The secretary also reported that during the quarter he had received 2 new covenants, one for £50 from Mr. N. P. Male and the other for £2 from Mr. A. Brownlee.

Life Members

On the motion of the President, it was unanimously resolved that Mr. J. T. R. Evans and Mr. Norman P. Male be elected life members of the Fund.

Cases

No. 52. Widow, aged 84. Receiving an allowance from the National Assistance Board.

It was resolved that the present grant of £1 per week be continued for another year, and that arrangements be made for a supply of coal to be made in this case.

No. 240. Daughter of late member, aged 65. Weekly income: N.I. pension and a small amount under a legacy. It was agreed that the present grant of £2 per week be not disturbed for the next 12 months.

No. 292. Widow, aged 76. The President reported that this recipient's application for an increased grant (referred to the Executive Committee by the Council at its last meeting) had received careful consideration and the committee had decided to increase the grant from 30s. to £2 per week as from May 1st.

It was resolved that the action of the Executive Committee be approved.

No. 305. Widow, aged 64. Two sons and 3 daughters, all married. Youngest son married last November. It was decided that the grant of £2 per week be continued for a further year.

No. 326. Widow, aged 33. Three children between 9 and 3 years. The secretary, having read the correspondence received from this recipient since the previous meeting, *it was resolved* that as from August 1st, the grant be reduced to £3 per week and that this case be further discussed at the next meeting.

No. 327. Widow, aged 37. Seven children between 12 and 3 years. Receiving £1 per week towards eldest son's education. It was decided that notwithstanding this applicant's letter of July 9th, the present grant be continued until the receipt of a further report from a local member of the profession.

No. 345. Widow, aged 75. The secretary, having reported the financial position of this recipient to be the same as at the last meeting. *It was resolved* that the present grant of £2 per week be continued until the next meeting.

No. 347. Widow, aged 49. At present holding a temporary position. Two children, daughter, aged 22, private secretary, and son, aged 12. Case referred to the Executive Committee at the last meeting. The committee reported that in the special circumstances, it had decided to make a temporary grant of £2 per week towards the son's education to take effect as from May 1st, 1961. The Council approved the action taken.

No. 348. Widow. Application for special financial assistance. Husband's pension ceased at his death. It was agreed that the offer of a member of Council to visit this case be warmly accepted. In the meantime, a special grant of £20 was decided on.

No. 349. Widow, aged 49. One daughter, aged 21, at work. Application supported by the V.M.A. of Ireland Scrutinising Committee.

It was resolved that the decision arrived at by the Council be communicated to the hon. treasurer of the Scrutinising Committee; and that for the time being a grant of 30s. per week be made in this case, to take effect as from July 1st.

Visits to Recipients of the Fund

The President reported that in accordance with the instructions of the Council at its last meeting, the Executive Committee had given consideration to the proposed scheme and had drawn up a list of the recipients and the persons whom it recommends should undertake such visits.

The list was then discussed and approved, with certain alterations, and the secretary instructed to send a copy to all members of Council and other nominated persons.

Date of Next Meeting

This was left in the hands of the President.

Any Other Matters

Subscriptions under covenant. Mr. Norman P. Male pointed out that only 85 members of the profession paid their subscriptions under deed of covenant, and as this was a means whereby the Fund's income could be appreciably increased without further cost to the subscribers (who pay income tax at the standard rate) the meeting concurred with his proposal that the following be included on the next Council agenda:—

(i) To decide on the steps to be taken with a view to obtaining an increasing number of members to subscribe to the Fund under a deed of covenant;

(ii) To consider the principle as to whether outside bodies should be invited to contribute towards the income of the Fund under a deed of covenant.

PERSONAL

Mr. E. C. Straiton has made a film which has been chosen by the B.B.C. as an instructive documentary for competition in the Berlin Film Festival. The film was chosen from 170 documentaries and has been "dubbed" in three languages. This is only one of a number of films made by this member of the profession.

Engagement

MACINTYRE—ROBERTSON.—The engagement is announced between Gerald C. MacIntyre, B.V.M. & S., M.R.C.V.S., 29, Barker Street, Nantwich, Cheshire, and Nancy Robertson, 9 Douglas Crescent, Edinburgh.

Marriage

BRADSHAW—COLE.—At St. David's Church, Miskin, Glam., on October 28th, Philip Reginald Bradshaw, B.V.SC., M.R.C.V.S., of Cardiff, to Margot Cole, also of Cardiff.

Divisional News

THE LINCOLNSHIRE AND DISTRICT DIVISION

A meeting of the Division was held at the Angel Hotel, Brigg, on September 27th. The President, Mr. A. M. E. Carmichael, was in the chair, and there were present 22 members and 7 visitors.

Apologies for absence were received from 5 members.

Minutes and Matters Arising

The minutes of the previous meeting were read and approved. Arising from the minutes: 1. Meat Inspection Refresher Course. The hon. sec. reported that all arrangements were completed for the course to take place during the coming week-end, September 30th/October 1st, 1961, and that 14 members and 5 visitors were to attend. It was agreed that arrangements should be made to hold a similar course next year. It was pointed out by one member that the M.I. Course was "clashing" with the Glasgow Veterinary School Refresher Course, and that care should be taken that this did not occur next year. 2. Assistants' Meeting. The hon. sec. reported that arrangements had been made for this event to take place at the Eastgate Hotel, Lincoln, and that Allen & Hanburys Ltd. had agreed to provide films and a speaker, and to act as hosts for the evening. 3. Broken hypodermic needles in flesh food animals. Following a report from a member that, in a recent TV programme, in answer to a question on this subject, a "certain veterinary surgeon" had stated that the profession were taking no definite action in this matter, the hon. sec. was instructed to write to B.V.A. headquarters, urging them to make recommendations to the manufacturers of needles.

Correspondence

From the county secretary of the N.F.U., inviting the Division to be represented at the Diocesan Harvest Festival, at Lincoln Cathedral, and enclosing tickets for those members who wished to attend.

Membership

Mr. W. R. Duberley of Newark, Mr. N. Greig of Sleaford, Mr. J. D. L. Griffiths of Oakham, Mr. C. T. Jenkins of Grantham, and Mr. J. Lawson of Grimsby were elected to membership. Nominations were received for Mr. E. Gallagher of Nottingham, and Mr. K. Meldrum of Scunthorpe.

It was reported that resignations had been received from Mr. A. H. Adams, Miss C. M. Bird, Mrs. M. C. Clark, Mr. J. A. Field and Mr. R. H. Neill.

Arrangements for Next Meeting

The hon. sec. reported that the next ordinary general meeting of the Division would be held at the Grand Hotel, Peterborough, on November 22nd, 1961, and that Miss J. O. Joshua, F.R.C.V.S., had agreed to address members on "Virus Diseases in Dogs."

Election of Sub-committee on Fees

A proposal that "This Division should elect a sub-committee to formulate a scale of minimum fees for certain routine procedures, particularly in small animal work, for recommendation to all members," was approved by the meeting, and, in consequence, the following sub-committee was elected: Mr. A. M. E. Carmichael of Woodhall Spa, Mr. W. A. B. Barr of Lincoln, Mr. J. F. Birtwhistle of Scunthorpe, Mr. G. L. Beaumont of Market Rasen, Mr. H. H. Frost of Sleaford, Mr. J. A. Gibb of Bourne, Mr. J. Pengelly of Peterborough, Mr. J. E. Johnson of Leicester, Mr. D. F. Oliver of Grantham, and Mr. J. G. Loxam of Lincoln.

Other Business

1. The meeting agreed that the following donations should be made: £10 to the Victoria Veterinary Benevolent Fund, and £5 to the Veterinary Benevolent and Mutual Defence Society.

2. Annual Dinner and Dance. The hon. sec. reported that arrangements for this event were well in hand.

Address

In his opening remarks, Dr. A. C. Fraser expressed his pleasure at being invited to address the Division: at one stage of his career he had been in practice in the county, at Spilsby, and throughout his professional lifetime he had been a disciple of one of the Division's members, Mr. William Lang of Brigg. Dr. Fraser emphasised that, as in all branches of veterinary work, in horse practice the ordinary scientific principles applied. His address covered control, retained meconium, wounds, colic, worms, infections, coughing, tendons and lameness, and owners. The various conditions were enlarged upon by cases encountered, and, in consequence, the meeting was able to benefit from Dr. Fraser's vast experience and knowledge.

In opening the discussion, Mr. G. L. Beaumont commented on various aspects of Dr. Fraser's address, giving his opinions on treatments, etc. In addition he introduced his opinions on retained placenta, mastitis, navel-ill, grass sickness, castration, warbles and measuring. In the general discussion which followed, members called upon Dr. Fraser to answer numerous questions, and it was approaching midnight before the President asked Mr. J. E. Johnson to propose a vote of thanks to the speaker.

Assistants' Meeting at Lincoln

At the A.G.M. of the Lincolnshire and District Division it was resolved that, in addition to the regular Divisional meetings, an "Assistants' Meeting" should be arranged. On the evening of November 1st, at the Eastgate Hotel, Lincoln, this meeting took place, with Allen & Hanburys Ltd. acting as hosts.

All assistants in the Lincolnshire area were invited to attend, and were requested to bring along their principals, wherever possible. Thirty members of the profession, of whom 6 were principals, attended the meeting, and enjoyed an excellent programme.

(*Concluded at foot of col. 1 overleaf*)

News and Comment

CONFERENCE ON ARTERIAL DISEASES

This conference, convened by the Nuffield Institute of Comparative Medicine, will be held at the Zoological Society, Regent's, Park, on November 22nd, beginning at 10 a.m. Its objects are: to study the existing state of research in the U.K. in relation to diseases of the arterial system; to consider what contribution can be made by the Nuffield Institute of Comparative Medicine; to consider in what ways studies on comparative aspects of arterial diseases can be correlated and in particular how the programme of the World Health Organisation can be advanced in this country.

The Chairman will be Professor Sir Roy Cameron, F.R.S., Chairman of the Committee for the Nuffield Institute of Comparative Medicine.

Some of the papers are being given by, or will be of interest to, veterinary surgeons. They include the following: "Observations on Athero-sclerosis in Pigs," by J. E. French, Department of Pathology, Oxford University; "Current Research on the Athero-sclerosis Problem in Domestic Animals," by Professor W. I. B. Beveridge, Professor of Animal Pathology at Cambridge University; "Current Research on Athero-sclerosis in Wild Animals," by R. Finlayson, St. Bartholomew's Hospital, and C. Symons, M.D., B.S., M.R.C.P., of the Royal Free Hospital, who will outline researches at the London Zoo undertaken in collaboration with the Pathologist, Mr. R. N. Fiennes.

Divisional News.—*Concluded.*

Following a film on "Husk—Its cause and Prevention," members were addressed by Mr. A. M. K. Nelson of Allen & Hanburys Ltd. In his address, Mr. Nelson enlarged upon "husk," giving details of experimental work done and describing the use of Dictol as a preventive of the disease. A lively discussion ensued, with the speaker being called upon to answer numerous questions.

An interval, for buffet supper and refreshments, was followed by a film on "Profound Hypothermia," demonstrating the use of this technique in a heart operation carried out at the Westminster Hospital.

The remainder of the evening was given over to social discourse and the enjoyment of the hospitality offered by the hosts.

A vote of thanks to the speaker and to Allen & Hanburys Ltd. was proposed by Mr. J. D. L. Griffiths, of Oakham. Mr. Eastcott, area manager, responded on behalf of the speaker, his colleagues, Messrs. Bingham, Kirkby and Stubbins, and Allen & Hanburys Ltd.

The President and members of the Division, and the assistants in the Lincolnshire area, are indebted to Allen & Hanburys Ltd. for providing such an excellent evening. It is hoped, and confidently expected, that the "Assistants' Meeting" will become an annual event in the Lincolnshire calendar.

After tea a visit to the Animal Hospital in the Gardens has been arranged, and to the Pathology Laboratories where Group Captain J. E. Malcolm will demonstrate a "cardiac analogue" which he has designed and built.

It is hoped to publish an account of the veterinary aspects of this Conference in due course.

THE ANIMAL HEALTH DIVISION

The following changes have been, or are being, made in the Veterinary Field Staff:—

Promotions: Mr. G. Tullis, Deputy Regional Veterinary Officer, Newcastle upon Tyne, promoted Regional Veterinary Officer, Edinburgh, November 27th, 1961; Mr. A. Kelly, Divisional Veterinary Officer, Stafford, promoted Deputy Regional Veterinary Officer, Newcastle upon Tyne, November 27th, 1961; Mr. F. Dunlop, Veterinary Officer, Carlisle, promoted Divisional Veterinary Officer, Oban, October 16th, 1961; Mr. J. M. Brown, Veterinary Officer, Norwich, promoted Divisional Veterinary Officer, Lincoln, November 6th, 1961; Mr. A. Hamilton, Veterinary Officer, Cupar, promoted Divisional Veterinary Officer, Tolworth, November 6th, 1961; Mr. P. M. Marshall, Veterinary Officer, Preston, promoted Divisional Veterinary Officer, Stranraer, November 6th, 1961; Mr. E. Griffith, Veterinary Officer, Preston, promoted Divisional Veterinary Officer, Tolworth, November 13th, 1961; Mr. T. T. Hunter, Veterinary Officer, Leeds, promoted Divisional Veterinary Officer, Stafford, November 23rd, 1961.

Transfers: Mr. E. Clark, Regional Veterinary Officer, Cambridge, transferring to Reading on December 4th, 1961; Mr. J. R. Kerr, Regional Veterinary Officer, Edinburgh, transferring to Cambridge on November 30th, 1961; Mr. D. H. MacDonald, Divisional Veterinary Officer, Leeds, transferred to Elgin on September 7th, 1961; Mr. D. K. Bryson, Divisional Veterinary Officer, Chelmsford, transferred to Lewes on October 2nd, 1961; Mr. J. W. Ware, Divisional Veterinary Officer, Tolworth, transferred to Exeter on October 4th, 1961; Mr. T. W. Stobo, Divisional Veterinary Officer, Lincoln, transferring to Leamington Spa on November 27th, 1961.

Retirements: Mr. R. J. P. Watson, Divisional Veterinary Officer, Elgin, retired on September 7th, 1961; Mr. R. R. Willing, Divisional Veterinary Officer, Exeter, retired on October 10th, 1961; Mr. J. M. McQuaker, Divisional Veterinary Officer, retired on October 30th, 1961; Mr. J. C. Davidson, Divisional Veterinary Officer, Tolworth, retired on November 1st, 1961; Mr. S. V. Collard, Divisional Veterinary Officer, Leamington Spa, retired on November 5th, 1961; Mr. T. Y. Littler, Divisional Veterinary Officer, Tolworth, retired on November 11th, 1961; Mr. A. M. Graham, Regional Veterinary Officer, Reading, retires on November 30th, 1961.

MR. LIONEL MACKENZIE GOODALL

Professor McCunn writes:—

Lionel Goodall died during the early hours of November 7th, 1961. He had been a patient in the

Midhurst Sanatorium for a few weeks. Previous to that he had been, apparently, in his usual good health.

Lionel Goodall was the son of the late Dr. Edward W. Goodall, M.D., a renowned physician, who specialised in "fevers." He left school during the 1914-18 war and joined the army; after his preliminary training he obtained a commission in the Indian Army and served with the Gurkhas. He had decided to follow a military career but, like many others of his age group, he was "axed" when the forces were vigorously reduced by the Geddes committee. In his search for another career, and being a good horseman, he was attracted to the veterinary profession. He entered the Royal Veterinary College, with several others who were in a similar situation, and graduated M.R.C.V.S. in July, 1928. He purchased Mr. Neishe's practice in Hampstead, and after working for some years in this practice he was offered, and accepted, the appointment of veterinary adviser to one of the great film organisations. He directed and guided the equine activities depicted in several films which received world acclaim.

Goodall was a keen horseman, and as he had always been on friendly terms with the Metropolitan mounted police it was natural that he should be a member of the Mounted Branch reserve. In 1939 that reserve was mobilised, but within a few months Goodall rejoined the army and was posted to the military police branch. He served in the Near and Middle East, and attained the rank of Provost Marshal. About 10 years ago he and Mrs. Goodall retired to live first in Surrey and then in St. John's Wood. Being bored with complete retirement he returned to his profession assisting a friend in the latter's practice. He did not want to be tied down constantly, so during the last few years he served as locum tenens in many parts of the country mostly to help out old college friends who were in difficulty owing to illness and other causes. He also assisted at R.S.P.C.A. clinics. Goodall was a competent veterinary surgeon but it was not in his making to be tied down to one spot. I think that his later years, when he could go from place to place, view different scenes and yet enjoy the comforts of his home in St. John's Wood, were probably the happiest of his life.

He leaves a widow and a sister, who is in the nursing profession, to mourn his death.

MAJOR J. F. RANKIN

Mr. William R. G. West writes:—

To me and my family the passing of Major Rankin is a loss of a very dear friend. To the profession it means the loss of a member who brought it great respect.

He qualified in 1903 and joined the R.A.V.C. in 1905. After serving during the First World War in the Middle East, during which he was mentioned in despatches, he left the army and went into general practice, and became well known for his work with horses. He travelled abroad with the British show jumping team and was a well-known figure at three-day events. Although he retired from general practice several years ago, his knowledge of horses was so respected that he continued to travel about the country examining and treating them. He was still doing so on the eve of his last illness.

He was wise, kind and humble, and always willing to give to other members of the profession the benefits of his vast knowledge and experience. His friends will miss him very much.

R.C.V.S. OBITUARY

We record with regret the deaths of the following members of the profession:—

GOODALL, Lionel Mackenzie, Flat 121, 20, Abbey Road, St. John's Wood, London, N.W.8. Graduated from the Royal Veterinary College, London, July 13th, 1928. Died aged 66, November 7th, 1961.

RANKIN, John Fleming, T.D., Major, R.A.V.C. (T.A.) (retd.), 3, Alcombe Road, Minehead, Somerset. Graduated from the Glasgow Veterinary College, May 21st, 1903. Died, 1961.

WORTLEY, Walter Hunt, Major, R.A.V.C. (T.A.) (retd.). Examiner for the Royal College of Veterinary Surgeons, 1937-46. 34, Bridge Street, Bungay, Suffolk. Graduated from the Royal Veterinary College, London, July 9th, 1914. Died November 6th, 1961, aged 70. A memoir will be published shortly.

WELLCOME VETERINARY RESEARCH STATION, FRANT

Mr. R. M. Arnold, B.SC., M.R.C.V.S., has been appointed Deputy Head of the Wellcome Veterinary Research Station as from November 13th, 1961.

Mr. Arnold qualified at the Royal Veterinary College, London, in 1942. He was Assistant Veterinary Investigation Officer at Reading until 1946, when he accepted an appointment as Veterinary Investigation Officer, Jamaica. In 1950 he became Deputy Director of Agriculture (Veterinary & Livestock) in Jamaica, and later Superintendent of Livestock Services. In 1956 he was appointed Chief Veterinary Research Officer, Tanganyika, and served in that capacity until June, 1961.

"HISTORY OF THE OVERSEAS VETERINARY SERVICES"

The price of this newly-published work, which was reviewed at length last week, has been fixed at 30s. post free. It is available from B.V.A. Headquarters, 7, Mansfield Street, London, W.1.

COMING EVENTS

November

22nd (Wed.). LINCOLNSHIRE AND DISTRICT DIVISION. Meeting at the Grand Hotel, Peterborough, 2.15 p.m.

SOUTH EASTERN VETERINARY ASSOCIATION. Meeting at the Royal Star Hotel, Maidstone, 7.15 p.m.

CORNWALL VETERINARY CLINICAL CLUB. Meeting at the Royal Hotel, Bodmin, 7.30 p.m.

SOUTH-EAST MIDLANDS VETERINARY ASSOCIATION. Meeting at the Franklins Gardens Hotel, 7.30 p.m.

LAKELAND VETERINARY ASSOCIATION. Meeting at the Tufton Arms Hotel, Appleby, 6 p.m.

23rd (Thurs.). V.V.B.F. COUNTY OF AYR LADIES' GUILD. Annual Buffet Dance in the Western Hotel, Ayr, 8 p.m.

ESSEX VETERINARY SOCIETY. Meeting at May & Baker Research Station, Fyfield Road, Ongar, Essex, 7.30 p.m.

HERTS. AND BEDS. VETERINARY SOCIETY. Meeting at the Sun Hotel, Hitchin, 7.30 p.m.

WEST OF SCOTLAND DIVISION. Meeting at the University Veterinary Hospital, Bearsden, 7.30 p.m.

EAST MIDLANDS DIVISION. Meeting at the Mackworth Hotel, Mackworth, Nr. Derby, 7.40 p.m.

24th (Fri.). ASSOCIATION OF VETERINARY FOOD HYGIENISTS. Meeting at 7, Mansfield Street, Portland Place, London, W.1, 10 a.m.

NORTH WALES DIVISION. Annual General Meeting at the Gwydyr Hotel, Bettws-y-Coed, 2 p.m.

27th (Mon.). EAST YORKSHIRE CLINICAL CLUB. Meeting at the Talbot Hotel, 8 p.m.

29th (Wed.). SOUTHERN COUNTIES VETERINARY SOCIETY. Meeting at the Polygon Hotel, Southampton, 7.30 p.m.

B.S.A.V.A. METROPOLITAN REGION. Joint Meeting with the Hounslow Veterinary Club, 7.30 p.m.

30th (Thurs.). WESTERN COUNTIES VETERINARY ASSOCIATION. Meeting at Agriculture House, Exeter, 2.15 p.m.

December

1st (Fri.). SOUTH WALES DIVISION. Meeting at the Park Hotel, Cardiff, 2.15 p.m.

LAKELAND VETERINARY ASSOCIATION. Dinner Dance at the Old England Hotel, Windermere, 7.30 p.m.

ROYAL COUNTIES VETERINARY ASSOCIATION. Meeting at the Caversham Bridge Hotel, Reading, 2.30 p.m.

V.V.B.F. NORTH WALES DIVISION. Annual Dinner Dance in the Royal Lido, Prestatyn, 7.30 p.m.

6th (Wed.). A.V.T. & R.W. SCOTTISH GROUP. Meeting in the Assembly Hall at the University of Glasgow Veterinary Hospital, Bearsden Road, Bearsden, 2.30 p.m.

B.S.A.V.A. MIDLAND REGION. Meeting in Simon's Lounge, Grand Hotel, Leicester, 8.15 p.m.

B.S.A.V.A. KENT REGION. Meeting at the Great Danes Hotel, Ashford Road, Maidstone, Kent, 7.45 p.m.

7th (Thurs.). AYRSHIRE VETERINARY ASSOCIATION. Meeting in the New Building, Auchincruive, 7.30 p.m.

8th (Fri.). WESTERN COUNTIES VETERINARY ASSOCIATION. Annual Dinner and Dance at the Rougemont Hotel, Exeter, 7 p.m.

13th (Wed.). NORTH OF ENGLAND VETERINARY MEDICAL ASSOCIATION. Annual Dinner Dance in aid of the V.V.B.F. at the Banqueting Rooms, Gosforth Park Race Course, Newcastle upon Tyne, 7.30 p.m.

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the date on which disease has been confirmed, followed by the postal address and local authority.

Anthrax

November 7th, 1961. F. Keen & Sons, Wing Road Farm, Stewkley, Leighton Buzzard, Beds. (Parish: Stewkley). (Cattle.) BUCKINGHAMSHIRE.

November 7th, 1961. L. R. Robinson, Brook Villa, Manchester Road, Tideswell, Buxton, Derbys. Disease at: Highfield Farm, Tideswell, Buxton, Derbys. (Parish: Tideswell). (Cattle.) DERBYSHIRE.

November 9th, 1961. Sir J. W. V. Ingilby, Home Farm, Ripley Castle, Ripley, Yorks. (Parish: Ripley). (Cattle.) YORK, WEST RIDING.

November 9th, 1961. L. G. Gregson & Son, Hanbury House Farm, Hanbury, Burton-on-Trent, Staffs. (Parish: Hanbury). (Cattle.) STAFFORDSHIRE.

November 9th, 1961. A. Spence, West Mains, Kincaldrum, Forfar, Angus (Parish: Inverarity). (Cattle.) ANGUS.

November 10th, 1961. J. W. Allsop (Stanley Allsop & Sons), Town End Farm, Kirk Ireton, Derby (Parish: Kirk Ireton). (Cattle.) DERBYSHIRE.

November 13th, 1961. Messrs. E. W. Pepper Ltd., Wyndmere, Steeple Morden, Royston, Herts. Disease at: Brook Orchard Farm, Bassingbourn, Cambs. (Parish: Bassingbourn). (Swine.) CAMBRIDGESHIRE.

Fowl Pest

November 8th, 1961. G. W. Butler, Green Farm, Yoxford, Saxmundham, Suffolk. EAST SUFFOLK.

November 8th, 1961. E. W. Goleby, Green Farm, Bedingfield, Eye, Suffolk. EAST SUFFOLK.

November 8th, 1961. A. Wander Ltd., Ovaltine Egg Farm, King's Langley, Herts. HERTFORDSHIRE.

November 9th, 1961. W. Rose, Bloomfields Farm, Wetheringsett, Stowmarket, Suffolk. EAST SUFFOLK.

November 9th, 1961. A. Moore & Sons, Denham Hall, Denham, Diss, Norfolk. EAST SUFFOLK.

November 9th, 1961. A. Houghton, Purlieu, Gloucester Road, Staverton, Cheltenham, Glos. GLOUCESTERSHIRE.

November 12th, 1961. A. S. Theobald, Tabrums Farm, Battlebridge, Wickford, Essex. ESSEX.

November 12th, 1961. E. O. Carpenter, Bel Air, Toms Lane, King's Langley, Herts. HERTFORDSHIRE.

November 13th, 1961. M. W. Foulger, The Factory, Banham, Norwich, Norfolk. NOR 05 K. NORFOLK.

November 13th, 1961. P. Mierwinski, Helderlea, Easingwold Road, Huby, Sutton-on-Forest, York. YORK. NORTH RIDING.

Swine Fever

November 8th, 1961. T. Sanderson, 13, Gertrude Street, Grasswell, Houghton-le-Spring, Co. Durham. Disease at: Grasswell Piggeries, Grasswell, Houghton-le-Spring, Co. Durham. COUNTY DURHAM.

November 8th, 1961. Col. J. F. Crimmin, Hoo House, Hoo, Woodbridge, Suffolk. Disease at: Low Barn, Hoo House Farm, Hoo, Woodbridge, Suffolk. EAST SUFFOLK.

November 9th, 1961. J. D. Gill, The Grange, Langthorpe, Boroughbridge, York. Disease at The Old Hall, Langthorpe, Boroughbridge, York. YORK, NORTH RIDING.

November 9th, 1961. J. B. Pollock, Bonnaughton Farm, Bearsden, Glasgow, DUNBARTONSHIRE.

November 9th, 1961. Miss K. M. Kitton and J. Russell, Ferndale, Church Lane, Barnham, Bognor Regis, Sussex. Disease at: Manor Farm, Church Lane, Barnham, Bognor Regis, Sussex. WEST SUSSEX.

November 9th, 1961. G. D. Mousley, Erwau, Horeb, Five Roads, Llanelly, Carms. CARMARTHENSHIRE.

November 9th, 1961. G. Brown, 241, Ilkeston Road, Nottingham. Disease at: Aldercar Piggeries, Aldercar Wood, Newstead, Notts. NOTTINGHAMSHIRE.

November 9th, 1961. W. J. Rowe, Fairwood, Broadfield, Saundersfoot, Pembs. Disease at: Carne Mill Farm, Templeton, Pembs. PEMBROKESHIRE.

November 9th, 1961. W. E. Baker, Floodgates Farm, Berkley, Glos. GLOUCESTERSHIRE.

November 10th, 1961. C. Walker, Yeld Lane Farm, Kelsall, Chester. CHESHIRE.

November 10th, 1961. Mrs. E. A. Jones, Penyfodau Fawr Farm, Kingsbridge, Gorseinon, Swansea, Glam. GLAMORGAN.

November 10th, 1961. G. H. Chelley, Cawsi Farm, Pontlasse, Morriston, Swansea, Glam. COUNTY BOROUGH OF SWANSEA.

November 13th, 1961. P. G. & S. K. Langrish, Pyle Farm, Horndean, Portsmouth, Hants. HAMPSHIRE.

November 13th, 1961. F. Hannan, Hill Top Farm, Crab Lane, Harrogate, Yorks. Disease at: Forest Road Piggeries, Knaresborough, Yorks. YORK, WEST RIDING.

November 13th, 1961. F. Hannan, Hill Top Farm, Crab Lane, Harrogate, Yorks. YORK, WEST RIDING.

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

The Treatment of Salmonellosis in Calves—A Correction

Sir,—In my Congress paper *Salmonellosis in Calves* I referred, in the section on treatment, to the use of furazolidone at an oral dosage rate of from 14 to 28 grammes (½ to 1 oz.) per day for calves of from 60 to 120 lb. bodyweight.

May I make it clear that this dosage rate refers to the use of a furazolidone* premix containing 4.4 *per cent.* of pure furazolidone.

This correction will be included in the paper when it is published in THE VETERINARY RECORD, but I would be glad if you would also bring it to the notice of those who have copies of the paper in the form in which it was distributed at the time of the Congress.

Yours faithfully,
E. A. GIBSON.

Ministry of Agriculture Veterinary Investigation Centre,
Norwich.
November 13th, 1961.

* Neftin.

The Behaviour of Cattle in Crushes

Sir,—I claim to be a bovine animal psychologist and have been following the letters in your esteemed journal, which followed on the publication of the article on the behaviour of cattle in crushes, with extreme interest. I want to congratulate Mr. E. G. Morris on his letter which appeared in the issue of October 14th. At last he has touched on the heart of the matter.

I would just like to elaborate a little further and state that an animal knows who can work with him sympathetically, and who not. The person who can work with him sympathetically is also your ideal stockman. The ideal stockman is born and not made. You can teach a lot of people how to handle stock but they never acquire the harmony of the born stockman.

In conclusion I want to state emphatically that the mental attitude, or make-up and temperament, has to be considered in all our dealings with the bovine animal.

Yours faithfully,
T. C. W. WESSELS.

P.O. Box 2,
Tweespruit O.F.S.,
South Africa.
November 8th, 1961.

The Use of Oxytetracycline in the Prevention of Neonatal Scouring in Piglets

Sir,—I read with much interest the article by Beckett, Cruickshanks and Ellis in THE VETERINARY RECORD of October 28th. The method they describe of pre-treating the sow with antibiotics has been successfully used for some time by practitioners in this area for the control of scours in young piglets. It has been found, however, that the antibiotic of choice varies from farm to farm according to the varied antibiotic sensitivities of the associated bacteria.

Our records on neonatal scours and deaths in young pigs over the past 3 years have shown that these organisms on *in vitro* tests vary considerably in their sensitivities. For example strains of *E. coli* isolated in 1958-9 varied in their sensitivities to different broad spectrum antibiotics from 75 per cent. sensitive to certain products to less than 40 per cent. to others. Over a 2-year period resistant strains to certain antibiotics have increased by 20 per cent.

It would seem, therefore, that it would be useful to know the *in vitro* sensitivities of the intestinal flora in all cases before commencing a herd treatment, and by reference to swabs taken at regular intervals check that resistant strains are not appearing. This would also enable one to determine whether clinical results and *in vitro* sensitivity tests agree, and allow a more efficient usage of the antibiotics of choice.

Yours faithfully,
NORMAN S. M. MACLEOD.

The Edinburgh School of Agriculture,
West Mains Road,
Edinburgh, 9.
November 10th, 1961.

Sir,—The correspondence dealing with scour in piglets and the use of Terramycin is of particular interest to me. This disease broke out in a herd of 100 breeding sows following the introduction of breeding gilts from an infected herd.

The use of scour serum made by two reliable manufacturers was not effective, neither was an autogenous serum made from the blood of slaughtered pigs which had recovered from the disease. Dimycin was also used but without success, and it was not until Terramycin Animal Formula was introduced into the drinking water of sows and piglets that there was a cessation of scouring. It became apparent after about 9 months that Terramycin was becoming ineffective due apparently to antibiotic

resistance on the part of the *Bact. coli* involved (isolated in the first instance as "OK.M434"). Up to this stage the disease had affected very few newly born pigs and was mostly attacking those reaching the age of 14 days; however, in spite of Terramycin scouring was now attacking all ages of pigs from birth to 6 weeks; after this age the piglets seemed immune.

In January of this year we received experimental samples of Socatyl paste and this drug was used on the small pigs with instant success. The paste was given orally on 3 consecutive days after birth. Scour was prevented in all cases. Treatment of already infected pigs was equally satisfactory.

I understand that Socatyl is not liable to produce resistant strains of bacteria and consequently it is expected that response to treatment will remain consistently good.

Yours faithfully,
W. B. QUARMBY.

Peel Place,
North Bar Without,
Beverley,
E. Yorks.
November 6th, 1961.

Sir,—Messrs. Beckett, Cruickshanks and Ellis's interesting account of the successful treatment of *E. coli* scours in piglets would have been more informative if it had contained details of the antibiotics previously used at the farm, and of the sensitivity of the gut pathogens in the young piglets to these drugs. In my experience a number of antibiotics can be used in this condition. They are all successful for a while but increasing resistance by the pathogens makes them eventually ineffective.

Mr. Wildgoose suggests that the source of infection is a subacute mastitis in the sow, but the trouble often seems to be associated with the buildings rather than with the sow. Frequently only one or two farrowing pens are affected, and all litters farrowed in these pens will scour even though the sows have previously and subsequently farrowed unaffected litters in other pens. It seems more probable that the injection of sows with oxytetracycline works by the single excretion of the antibiotic in the milk.

Yours faithfully,
G. DAVIES.

9, Archers Road,
Southampton.
November 8th, 1961.

Protection Against Canine Virus Diseases in Great Britain

Sir,—I have read Mr. Bateman's letter with much interest. I have the highest possible regard for his powers of clinical observation, which have contributed a great deal to our knowledge of immunisation against canine virus diseases, and I unhesitatingly accept his contention that 9 weeks is the appropriate age to vaccinate Greyhound puppies under the conditions which obtain in his kennels.

I would suggest, however, that not only are these conditions far more uniform but that they differ markedly in the breeding, rearing and management of G.R.A. Greyhounds from those found in the tremendously variable cross-section of the canine race with which the practising veterinary surgeon has to deal.

It is also noteworthy that re-vaccination at 15 months is the rule there, but in general practice I would submit that it is rather the exception than the rule. I am by no means satisfied that the whole story of the right age for vaccination lies in the transference of maternal antibodies, although this is undoubtedly a most important point. Other factors which I believe to influence the matter are so intangible that I hesitate to bring them into a scientific discussion.

To my mind young dogs undergo a transition from the state of infancy to that of puppyhood at ages varying between 8 and 12 weeks and I feel rather strongly that the canine infant does not respond immunologically to distemper antigens. Factors involved in this transition may include breed, nutritional status and familial tendencies and I find it quite impossible to define clinically the changes I observe between the infant and the puppy state. I have bred Chows in a small way for over 30 years and my puppies have always been quite self-supporting at 6 weeks of age and no longer infants at 9 weeks; but the majority of puppies presented in practice are not so advanced and many I still classify as infants at 10 weeks of age or even more. Since I am not prepared to set my patients at risk by immunising at what I believe to be too early an age, I have no records of immunisation at both ages to offer for comparison to support my views, the vast majority of my clients accepting my advice to immunise at 11 weeks or more, and I can thus still record only the one genuine breakdown which I mentioned in the discussion on Dr. Mansi's paper.

I accept the view that *most* puppies are susceptible to immunisation at 9 weeks but I am not prepared to have something like 20 per cent. of my clients living in a fool's paradise believing that their dogs are solidly immune when they are not. Furthermore, the exercising of young puppies other than by freedom of runs or gardens is in my view bad puppy management in any case and I therefore see no disadvantage in asking that they be so kept until 11 weeks of age. They are then ready to start outside exercise at 3 months of age, which in most cases is quite soon enough.

The neurotropic properties of the canine distemper complex of viruses render them so potentially lethal that it is the duty of every practising veterinary surgeon to give anxious thought to the conditions under which he will use our very high standard canine biological products and to ensure that the maximum number of dogs becoming immune as the result of vaccination.

There is probably no complete answer to our problems but I still do not like, and shall continue to resist, the "blanket" advice that 9 weeks is *the* age for immunisation of all puppies.

Yours faithfully,
JOAN O. JOSHUA.

78, Brentway,
Finchley, N.3.
November 13th, 1961.